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Analytical Report of Comprehensive Survey on the State of Science and Technology in Japan (NISTEP TEITEN Survey 2021)

February 2023

National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology

Center for S&T Foresight and Indicators

This document is the English version of the "Analytical Report of Comprehensive Survey on the State of Science and Technology in Japan (NISTEP TEITEN Survey 2021)" by tentative translation. NISTEP published the original Japanese version in August 2022. The English version is edited by YAMASHITA Izumi.

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Executive Summary

The Comprehensive Survey on the State of Science and Technology (NISTEP TEITEN Survey) is a continuous opinion survey which aims at comprehensively understanding the state of science, technology and innovation creation in Japan, including aspects that are difficult to grasp by quantitative indicators. It is unique in that the same respondents are continuously surveyed each year by a fixed questionnaire to enable measuring trends.

The respondents consist of active researchers and experts (non-researchers). The composition is based on the premise that by asking the same questions of the same content to those in different positions, the perceptions of each group can be grasped in a relative manner. The former is asked questions from the perspective of those engaged in R&D and other activities, while the latter is asked questions primarily from the perspective of managing such activities or observing them from the outside.

The survey questionnaire is developed from the perspective of (1) matters of universal importance in science, technology and innovation creation, and (2) matters that are given particular emphasis in the Science, Technology, and Innovation Basic Plan. The questionnaire consists of the following six parts: "1. Research personnel," "2. Research environment," "3. Research activities and support," "4. Industry-academia-government collaboration and the local community," "5.University functional expansion and strategic management," and "6. Science, technology, innovation, and society.

Current series of surveys (the fourth phase) has been/will be conducted over the five-year period from FY2021 to FY2025 during the Sixth Basic Plan. And the NISTEP TEITEN Survey 2021 as a part of the series was conducted as an online survey from November 29, 2021 to February 28, 2022. Responses were received from 2,128 respondents to the overall survey total of 2,262. The overall response rate is 94.1%. This report is a tentative translation of the NISTEP TEITEN Survey 2021 report in Japanese.

The findings from NISTEP TEITEN Survey 2021 include: (1) Issues in academic research and basic research and in securing research time are continuously recognized; (2) Lack of young researchers and students to enter a doctoral program are recognized; (3) Regional revitalization efforts are highly evaluated by researchers at universities mainly outside of metropolitan areas, while not by some groups of experts; and 4) Researchers in the social sciences and humanities tend to be positive in "securing competitive funding" and "introducing multi-faceted assessment of researchers," while negative in "transferring academic knowledge to ventures" and "diversifying career paths for PhD holders."

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Part 1: About the NISTEP TEITEN Survey

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1 Purpose of the NISTEP TEITEN Survey

The Comprehensive Survey on the State of Science and Technology (hereinafter referred to as "NISTEP TEITEN Survey") is a continuous opinion survey on the state of science and technology and innovation creation in Japan for active researchers and experts (non-researchers) in academia, industry and government.

Through a questionnaire developed based on the Science, Technology and Innovation Basic Plan (hereinafter referred to as "Basic Plan"), this survey will provide a comprehensive understanding of the status of science, technology and innovation creation and its changes, including aspects that are difficult to grasp using quantitative indicators. The survey is unique in that it is conducted on an annual basis with the same respondents. This series of surveys, the fourth phase, will be conducted over the five-year period from FY2021 to FY2025 during the 6th Basic Plan.

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Council for Science, Technology and Innovation (CSTI) have recognized that the results of the NISTEP TEITEN Surveys conducted during the 3rd through 5th Basic Plan periods provide valuable and unique data for a comprehensive and qualitative understanding of changes in the state of science, technology and innovation creation in Japan. The results of the NISTEP TEITEN Survey will play an even more important role in understanding the progress of the Basic Plan and in the formulation of the next Basic Plan, since they indicate changes in the real research activities that are difficult to grasp using quantitative data alone.

This report is a tentative translation of the NISTEP TEITEN Survey 2021 report, a report for the first survey of the fourth TEITEN Survey period and the reference point for future TEITEN Surveys. Since the survey respondents and questions have been updated with the commencement of the 4th TEITEN Survey, the results of the survey cannot be simply compared with those of the previous NISTEP TEITEN Surveys. NISTEP worked on the design, implementation, and compilation of the results of the survey, and was advised in the process by the "NISTEP TEITEN Survey Committee," which consists of related experts.

2 Overview of the NISTEP TEITEN Survey

The NISTEP TEITEN Survey 2021 was conducted as an online survey from November 29, 2021 to February 28, 2022. Responses were received from 2,128 respondents to the overall survey total of 2,262. The overall response rate is 94.1%.

In this section, the selection of respondents and the composition of the questionnaire is discussed. And the methods in tabulation of the survey results and how the results are presented.

2-1 Selection of respondents

For understanding the status of science and technology and innovation creation, taking into account the Basic Plan, it is necessary to grasp the status of universities and national research institutes that are engaged in R&D and innovation creation. It is also important to focus on the collaboration between universities, national research institutes, etc. and companies, especially in terms of innovation creation. Furthermore, by including respondents who have a bird's-eye view of the above activities in the survey, it would be possible to ascertain

opinions that go beyond the individual activities of the organizations to which the respondents themselves belong.

Based on the above, the respondents first are the active researchers who are actually engaged in R&D and innovation creation at universities and national research institutes. Since the activities of the researchers are supported by the organizations to which they belong, the university and national institute management level (people who take organizational managerial roles) also are the respondents of the survey. For conducting a survey that also focuses on the collaboration between universities, national research institutes, etc. and companies, it is necessary to include companies engaged in R&D and innovation creation as the respondents. High level experts with advisory roles to STI policies, such as members of government councils, should also be respondents to reflect their bird's-eye perspectives.

Based on the nature of their activities, the respondents selected for the survey are organized into two groups: a group of active researchers and a group of experts (non-researchers). The former group consists of researchers in the field of natural science at universities (hereinafter referred to as "natural science researchers"), researchers in the field of natural science at national research and development agencies or inter-university research institutes (hereinafter referred to as "natural science researchers at national institutes"), priority programs researchers selected separately from the former two groups, and social sciences and humanities researchers at universities, inter-university research institute corporation, etc. (hereinafter referred to as "SSH researchers"). Government priority programs refer to the Strategic Innovation Promotion Program Phase 2 (SIP2), Moonshot Research and Development Program, COI Fund for Young Researchers, and Fusion Oriented Research for Disruptive Science and Technology, all of which are mentioned in the Basic Plan. The reason why researchers in the natural sciences and government priority programs researchers are selected separately is that the situation of researchers supported by government priority programs can differ from that of other researchers. The group of active researchers comprises approximately 1,500 respondents in total. The group of experts (non-researchers) consists of approximately 800 people, including university and national institute management level, company representatives and R&D managers, and members of government councils. For the representatives and R&D managers of companies, subgroups were set up for large companies and SMEs and university ventures, taking into account the possibility that their perceptions may differ depending on the size of the company. Details of the actual selection procedure and other details of the selection of respondents are described in the Part 3 of the Japanese version.

Unlike the 3rd NISTEP TEITEN Survey (FY 2016-20), SSH researchers were added to the respondents in the 4th TEITEN Survey. This is due to the revision of the Basic Act on Science, Technology and Innovation to include the social sciences and humanities in the scope of science and technology. The Sixth Basic Plan, on which the 4th TEITEN Survey is based, also reflects this revision. The overall picture of the survey subjects is as follows.

Figure 1-. 1 Overall picture of respondents

Active researchers (about 1,500 people)	University natural science researchers
	Natural science researchers at national institutes
	Priority program researchers*1
	SSH researchers*2
Experts (non-researchers) (about 800 people)	University management level
	National institute management level
	Companies (large companies; SMEs and university ventures)
	High level experts with advisory roles to STI policies

Note 1: Government priority program researchers are researchers in the natural science field who have been selected as principal investigators for the Strategic Innovation Promotion Program Phase 2 (SIP2), Moonshot Research and Development Program, COI Young Researchers Collaborative Research Fund, and Fusion Oriented Research for Disruptive Science and Technology, as mentioned in the Basic Plan. They are selected separately from natural science researchers at universities and natural science researchers at national research institutes.

Note 2. The social sciences and humanities were added to the scope of this survey as part of the Sixth Basic Plan.

Regarding university natural science researchers, the respondents were selected so that the data could be tabulated by university group based on the share of papers and by university department field. Previous surveys have shown that response trends differ by those attributes. University groups are categorized using the share of papers (natural sciences, fractional count) among Japanese universities in 2015-19 (Figure 1-2). Universities with a share of 4% and more of the total number of papers are classified as Group 1, those with a share of 1% and more to less than 4% as Group 2, those with a share of 0.5% and more to less than 1% as Group 3, and those with a share of 0.05% and more to less than 0.5% as Group 4. As for inter-university research institute corporation, 19 research institutes/facilities as divisions of the 4 corporations were selected. For national research and development agencies, 24 institutions were selected, excluding the 3 institutions that mostly distribute R&D funding. The universities and national research institutes that were surveyed are described in Part 3 of the Japanese version.

Figure 1-2. University classification based on paper share in Japan and department extraction policies

University group	Share of papers (among Japanese universities)	Number of universities	4th NISTEP TEITEN Survey
1	Top 4 universities out of 1% and more	4(4, 0, 0)	Extract all
2	1% or more (excluding top 4 universities)	14(11, 0, 3)	Extract all
3	0.5 and more to less than 1%	26(16, 4, 6)	Extract about 2/3
4	0.05 and more to less than 0.5%	137(37, 18, 82)	About 1/2 for science, engineering and for agriculture About 1/3 for health
Whole	-	181(68, 22, 91)	181

*1Compiled by the National Institute of Science and Technology Policy based on Clarivate's Web of Science XML (SCIE, version at the end of 2020).

2 Figures in parentheses are the number of applicable national universities, public universities, and private universities.

2-2 Questionnaire Structure

Based on the Sixth Basic Plan, and with the objective of understanding the status of science, technology and innovation creation in Japan, a questionnaire was developed from the perspective of (1) matters of universal importance in science, technology and innovation creation, and (2) matters of particular emphasis in the Basic Plan. The questionnaire consists of the following six parts: "1. research personnel," "2. research environment," "3. research activities and support," "4. industry-academia-government collaboration and the local community," "5. university functional expansion and strategic management," and "6. science, technology, innovation and society."

The research personnel part consists of sub-categories of "young researchers," "young students aspiring to become researchers," "female researchers," "foreign researchers," and "evaluation of researchers' performance." The Basic Plan describes efforts to promote the activities of young researchers and female researchers and to promote brain circulation to rebuild an environment that generates diverse and outstanding research. The objective of the part is to understand the environment in which researchers with the above attributes are placed. In addition, the evaluation of researchers' performance is generally asked, not limited to specific attributes.

The research environment part consists of sub-categories of "research resources," "research facilities and equipment," and "transformation of research activities." The Basic Plan seeks to promote efforts to secure research time and improve research facilities and equipment to rebuild an environment that generates diverse and outstanding research. In addition, for the establishment of a new research system (promotion of open science and data-driven research, etc.), the plan describes efforts to develop infrastructure and build an environment that will support the transformation of research activities in line with the development of new technologies such as AI and virtual technologies. In the part, the status of the research environment in which researchers at universities, national research institutes, etc. are placed is grasped from the aspects that are universally important for conducting research, such as status of information infrastructure for research, research funds, research time, and research facilities and equipment, as well as from the aspect of the transformation of research activities that is currently progressing rapidly.

The part on research activities and research support consists of sub-categories of "academic research and basic research" and "government research funding management." The Basic Plan describes efforts to promote academic research and basic research to rebuild an environment that generates diverse and outstanding research. The purpose of the part is to grasp the status of the promotion of academic research and basic research, as well as the status of the government's efforts to allocate funds to support such research. Regarding the latter, the section focuses mainly on the support provided through funding agencies, since a question on support by recurrent or block grant funding is asked in the sub-category of "research resources" in the research environment part.

The industry-academia-government collaboration and the local community part consists of the sub-categories of "knowledge-based value creation," "intellectual property management," "regional revitalization," and "innovation talent development." The Basic Plan describes the promotion of new value co-creation through industry-academia-government collaboration in the context of the formation of an innovation ecosystem. The

objective of the part is to grasp the status of efforts to utilize the outputs of R&D while applying them to industry and society. The status of human resource development for such activities is also within the scope of the part.

The part of "university functional expansion and strategic management" consists of the sub-categories of "university management" and "university functional expansion." In the Basic Plan, there are specific initiatives including the transformation of national university corporations into true management entities, deregulation to support strategic management, and the creation of a 10 trillion-yen university fund for promotion of university reform and university functional expansion for strategic management. Based on that, the part asks questions mainly on the status of activities of universities for self-reform and securing various financial resources in the sub-category of "university management" and on the status of universities from the perspective of society and deregulation to support university management in the sub-category of "university functional expansion".

The part of "science, technology, innovation and society" consists of sub-categories of "status of relations with society," "utilization of 'comprehensive knowledge'," "building an innovation system," "promotion of open innovation," "international collaboration" and "research integrity." The Basic Plan states that to realize transformation into a sustainable and resilient society that ensures the safety and security of its citizens, it is necessary to (1) promote R&D and social implementation and utilize "comprehensive knowledge" to solve various social issues, and (2) form an innovation ecosystem that will serve as a foundation for creating new industries based on value co-creation. Among the sub-categories that make up the part, "status of relations with society" and "utilization of 'comprehensive knowledge'" are questions related to (1), and are intended to qualitatively understand the progress of the "comprehensive knowledge" presented in the Basic Plan. In addition, the questions on "building an innovation system" and "promotion of open innovation" are related to (2), and will focus on innovation policies such as the introduction or relaxation of regulations, establishment of venues for demonstration experiments, financial and fiscal support, and a system that would promote standardization. In addition, questions on the status of "international collaboration" and "research integrity" also are asked in the same part, since internationalization is an important perspective in conducting research activities and concerns about outflow of scientific and technological information, etc. have been increasing in recent years.

The structure of the questionnaire explained above is shown in Figure 1-3.

Figure 1-3. Questionnaire structure

Part	Sub-category	Num. of questions
Research personnel	Young researchers	4
	Young students aspiring to become researchers	3
	Female researchers	3
	Foreign researchers	1
	Evaluation of researchers	2
Research environment	Research resources	5
	Research facilities and equipment	3
	Transformation of research activities	5
Research activities and support	Academic research and basic research	4
	Government research funding management	5
Industry-academia-government collaboration and the local community	Knowledge-based value creation	4
	Intellectual property management	2
	Regional revitalization	2
	Innovation talent development	2
University functional expansion and strategic management	University management	3
	University functional expansion	2
Science, technology and innovation and society	Status of relations with society	3
	Utilization of "comprehensive knowledge"	2
	Building an innovation system	4
	Promotion of open innovation	2
	International collaboration	2
	Research integrity	2
Total number of questions		65

The method of answering the questions is to select the most appropriate answer from six levels (Insufficient ←→ Sufficient) (6-point scale questions). Some questions are common to the past TEITEN Surveys, which are items considered important for observing the status of science and technology and innovation creation.

The scope of the questions is specified as either the "department" or "organization" to which the respondents belong, the "organization" to which the respondents are related, the "field" to which the respondents belong, or "Japan as a whole". The concrete questions and their correspondence to the respondent groups are presented in Part 3 of the Japanese version. In many questions, active researchers were asked about the situation of the organization or department to which the respondent belongs, experts (university management level and national institute management level) were asked about the situation of the organization to which the respondent belongs, companies were asked about the situation of the organization with which the respondent is associated or Japan as a whole, and the high level experts with advisory roles to STI policies were asked about the situation of Japan as a whole.

2-3 Analytical Perspectives and Methods of Tabulating Survey Results in the NISTEP TEITEN Survey

In analyzing the results of the survey based on the previously mentioned questions, emphasis will be placed on what trends exist in the responses according to the attributes of the respondents. This is because it would provide important clues for understanding the state of science and technology and innovation creation in Japan, such as differences in opinions between researchers and the university management level, and among university groups. The purpose of the NISTEP TEITEN Survey is to obtain a bird's-eye view of the status of research and development and innovation creation in Japan, not to evaluate individual universities or national research institutes.

In tabulating the results of the survey, focus will be placed on the characteristics of the overall trend of responses for each of the respondent groups that were set up when the survey was conducted. For example, the results for university natural science researchers will be tabulated by total, university group, university department field, gender, and so on. In order to compare the results with those of university natural science researchers, the responses of government priority programs researchers and experts (non-researchers) will also be tabulated.

Population estimates were made for the respondent groups of natural science researchers at universities, natural science researchers at national research institutes, and SSH researchers. The relationship between the number of responses for each stratum and the size of the population is shown in Figure 1-4 Note that the proportion of female respondents to the size of the population is much higher than that of male respondents regarding university natural science researchers. It reflects the oversampling to fully capture the opinions of female respondents, given the low percentage of female researchers in Japan as a whole. Details of the population and population estimates are presented in Part 3 of the Japanese version.

The natural science researchers at universities are divided into subgroups by university group, by university departmental field, and by gender to make comparisons among those strata. Since previous NISTEP analyses have shown that the situation and response trends differ by university group and departmental field,

comparisons will be made among them. In addition, since it is assumed that there may be differences in responses by gender for some question items, comparisons will also be made by gender. Here, university group is an attribute in which NISTEP categorizes each university into four groups based on the share of the number of papers (the number of papers in the natural science field in a certain university / the number of papers in the natural science field of all Japanese universities) as previously mentioned. In addition, university department field is a field category set in the Survey of Research and Development by the Ministry of Internal Affairs and Communications[1] . The details of the university groups are described in Part 3 of the Japanese version.

Figure 1-4. Number of responses and population size by strata

Stratum			Num. responses	Population size*
University natural science researchers	Whole		865	33,085
	Univ. group	Group 1	196	6,276
		Group 2	232	9,403
		Group 3	237	8,318
		Group 4	200	9,089
	Scientific field	Science	161	4,858
		Engineering/Agriculture	418	14,670
		Health	286	13,558
	Sex	Male	485	27,871
		Female	380	5,214
Natural science researchers at national			149	6,781
Government priority program researchers			279	800
SSH researchers			93	2,145
University management level			247	267
National institute management level			64	67
Companies	Whole		271	4,098
	Company type	Large companies	156	831
		SMEs and university ventures	115	3,267
High level experts with advisory roles to STI policies			160	934

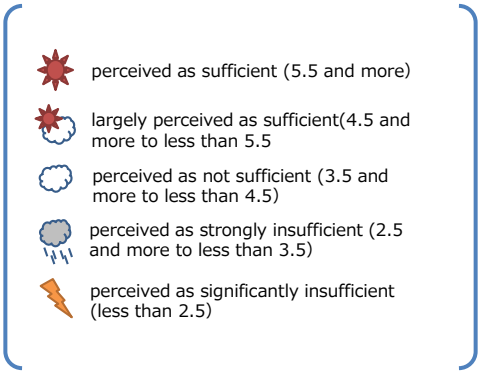
NOTE : The population size for university natural science researchers, natural science researchers at national research institutes, and SSH researchers is the sum of the weights assigned to each respondent for population estimation. The population size for government priority programs researchers, companies, and high level experts with advisory roles to STI policies represents the size of the list used in conducting the random sampling. For the university management level and national institute management level, the number of respondents to whom questionnaires were sent is used as the size of the population, since it is nearly an all-inclusive survey for them.

2-4 Display of results by index and interpretation of the index

In the report, the results of the 6-point scale questions will be discussed using an index based on conversion of the results into values ranging from 0 to 10 points. Specifically, the 6-point scale is converted from "1" to 0 points, "2" to 2 points, "3" to 4 points, "4" to 6 points, "5" to 8 points, and "6" to 10 points, and the average values are tabulated by attribute (e.g., by university group and by university department field). Note that population estimates were used in the calculation of the index. The interpretation of the index is shown in the Figure 1-5. And the approach used in interpreting the index is presented in Section 3 of the Japanese version.

[1] Although engineering and agriculture are classified separately in the Ministry of Internal Affairs and Communications survey, engineering and agriculture are combined in the survey to secure enough samples for those strata.

Figure 1-5. Indices and their interpretation in the report



2-5 About Free Descriptions from open-ended questions

The NISTEP TEITEN Survey 2021 also includes open-ended questions at the end of each question part. The results are presented in the text as a summary of the points of multiple statements, which may have been influenced by the subjectivity of the authors of this report.

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Part 2: Details of Survey Results

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1 Research personnel

The research personnel part consists of sub-categories of "young researchers," "young students aspiring to become researchers," "female researchers," "foreign researchers," and "evaluation of researchers' performance. The Basic Plan describes efforts aimed at promoting the activities of young researchers and female researchers and promoting brain circulation to rebuild an environment that generates diverse and outstanding research. The purpose of this part is to understand the environment in which researchers with the above attributes are placed. In addition, the sub-category of evaluation of researchers' performance is not limited to specific attributes.

1-1 Young researchers

In the sub-category of young researchers, the following four questions were asked to active researchers and to a part of experts (non-researchers): university management level and national institute management level. In addition, two questions, Q101 and Q104, were asked to "high level experts with advisory roles to STI policies" among experts (non-researchers). Note that "young researchers" in the survey is defined as "postdoctoral fellows, researchers, assistant professors, associate professors, etc., up to about 39 years of age, excluding doctoral students".

- ○ Q101: Do you think young researchers (excluding doctoral students) have sufficient opportunities to be independent and active?
- ○ Q102: Do you think the number of young researchers independently conducting R&D is sufficient?
- ○ Q103: Do you think the organizational efforts are sufficient for expanding the number of tenured positions for promising young researchers?
- ○ Q104: Do you think young researchers is sufficiently supported for pursuing their studies abroad (e.g., securing opportunities, financial support, evaluation of their pursuit, and so on)?

In all questions, active researchers were asked about the status of their departments, university management level and national institute management level were asked about the status of their organizations, and high level experts with advisory roles to STI policies were asked about the overall status of Japanese universities and national institutes.

Figure 2-1. List of questions and indices about young researchers

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q101: Establishing an environment for young researchers to be independent and active	4.9	5.5	5.2	4.6	4.6	5.4	5.4	4.3	5.0	4.8	6.0	4.6	5.3
Q102: Number of young researchers independently conducting R&D	3.8	4.6	4.0	3.3	3.5	4.1	4.1	3.4	3.8	3.8	3.9	3.3	4.4
Q103: Expanding tenured employment for young researchers with proven track records	3.9	3.2	4.1	3.8	4.1	3.3	4.7	3.2	3.9	3.7	4.0	3.0	4.1
Q104: Establishment of an environment for young researchers to pursue their studies abroad	3.8	4.7	4.1	3.3	3.3	4.5	4.0	3.4	3.8	3.7	5.3	3.6	4.5

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q101: Establishing an environment for young researchers to be independent and active	5.4	6.3	–	–	–	3.0
Q102: Number of young researchers independently conducting R&D	3.9	4.3	–	–	–	–
Q103: Expanding tenured employment for young researchers with proven track records	4.4	5.5	–	–	–	–
Q104: Establishment of an environment for young researchers to pursue their studies abroad	4.7	5.3	–	–	–	2.9

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q101: Establishing an environment for young researchers to be independent and active," the overall index for university natural science researchers (a part of active researcher) is 4.9 (largely perceived as sufficient). By university group, Group 1 (5.5) and Group 3 and Group 4 (4.6) have a difference of 0.9 in the index. By university department field, there is a difference of 1.1 in the index between science (5.4) and engineering/agriculture (5.4) and health (4.3). The index for natural science researchers at national research institutes is 6.0 (perceived as sufficient), 4.6 for government priority programs researchers (largely perceived as sufficient), and 5.3 for SSH researchers (largely perceived as sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 5.4 (largely perceived as sufficient) and 6.3 (perceived as sufficient), respectively. High level experts with advisory roles to STI policies has an index of 3.0 (perceived as strongly insufficient). Note that the index of 4.9 for all university natural science researchers is 1.9 higher than the index of 3.0 for high level experts with advisory roles to STI policies.

In "Q102: Number of young researchers independently conducting R&D," the overall index for university natural science researchers (a part of active researchers) is 3.8 (perceived as not sufficient). By university group, there is a 1.3 difference in the index between Group 1 (4.6) and Group 3 (3.3). The index for natural science researchers at national institutes is 3.9 (perceived as not sufficient), 3.3 for government priority programs researchers (perceived as strongly insufficient), and 4.4 for SSH researchers (perceived as not sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.9 (perceived as not sufficient) and 4.3 (perceived as not sufficient), respectively.

In "Q103: Expanding tenured employment for young researchers with proven track records," among active researchers, the overall index for university natural science researchers is 3.9 (perceived as not sufficient). By university group, there is a difference of 0.9 in the index between Group 2 and Group 4 (4.1) and Group 1 (3.2). By university department field, there is a difference of 1.4 and 1.5 in the indices for engineering and agricultural science (4.7) and science (3.3) and health (3.2), respectively. The index for natural science researchers at national institutes is 4.0 (perceived as not sufficient), 3.0 for government priority programs researchers (perceived as strongly insufficient), and 4.1 for SSH researchers (perceived as not sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 4.4 (perceived as not sufficient) and 5.5 (perceived as sufficient), respectively. The index is 4.0 for natural science researchers at national institutes, a difference of 1.5 points compared to 5.5 for management level at national institute management level.

In "Q104: Establishment of an environment for young researchers to pursue their studies abroad," the overall index for university natural science researchers (a part of active researchers) is 3.8 (perceived as not sufficient). By university group, there is a difference of 1.4 in the index between Group 1 (4.7) and Group 3 and Group 4 (3.3). By university department field, there is a 1.1 difference in the index between science (4.5) and health (3.4). The index for natural science researchers at national research institutes is 5.3 (largely perceived as sufficient), 3.6 for government priority programs researchers (perceived as not sufficient), and 4.5 for SSH researchers (largely perceived as sufficient). Among experts (non-researchers), the indices for university management level and national institute management level were 4.7 (largely perceived as sufficient) and 5.3 (perceived as sufficient), respectively. Note that the index of 3.8 for university natural science researchers as a whole is 0.9 higher than the index of 2.9 for high level experts with advisory roles to STI policies. The index of 4.7 for the university management level differs by 0.9 from the index of 3.8 for all university natural science researchers.

Based on the above, while "Establishing an environment for young researchers to be independent and active (Q101)" is largely perceived as sufficient for many attributes, there is a tendency for "Number of young researchers independently conducting R&D (Q102)" to be perceived as not sufficient. In both questions, there are differences among university groups, with Group 1, the university with the largest share of papers, having a relatively high index. Comparing the perceptions of "Number of young researchers independently conducting R&D (Q102)" and "Expanding tenured employment for young researchers with proven track records (Q103)," the latter index is lower than the former for Group 1. It suggests that although there are a certain number of young researchers who conduct R&D independently, they are not sufficiently offered tenured employment. There are many comments from open-ended questions related to the point that "there are not enough non-

tenured positions for young researchers due to capacity reduction," as well as "Although the hard environment for conducting research is good, there is a problem in that young researchers are forced to move from one non-tenured position to another. We cannot pay for our own personnel expenses from the project research funds, so we would like to see the expansion of tenure positions." Furthermore, "Establishing an environment for young researchers to be independent and active" (Q101) and "Establishing an environment of an environment for young researchers to pursue their studies abroad" (Q104) tended to be rated lower by high level experts with advisory roles to STI policies than by researchers and management level of university and national institute management level.

Other issues raised in the open-ended answers regarding the sub-category include: "In order to increase the number of young researchers, the treatment of mid-career researchers, who are the future of young researchers, should be improved," "Since it is difficult for young researchers to become independent given the amount of funding in Japan, it would be better if young researchers could freely conduct research while remaining under the supervision of a professor," "Since the employment funds for non-tenured researchers have a time limit, it is difficult for them to take a long leave of absence in response to their life events," and "There are problems such as the lack of clear conditions for promotion, and the lack of promotion prospects after moving to a tenured post."

1-2 Young students aspiring to become researchers

In the sub-category of young students aspiring to become researchers, the following three questions were asked to active researchers except for researchers in national institutes and university management level among experts (non-researchers). In addition, two questions, Q106 and Q107, were asked to high level experts with advisory roles to STI policies among experts (non-researchers). The term "young students aspiring to become researchers" in the survey is defined as those who are going to be enrolled / are enrolled in a doctoral program.

- ○ Q105: Do you think the number of students with desirable abilities who are pursuing doctoral studies is sufficient?
- ○ Q106: Do you think the students with desirable abilities are sufficiently supported and motivated to enter the doctoral program?
- ○ Q107: Do you think there are sufficient efforts to create an environment in which PhD holders can choose a variety of career paths, including paths outside of academia?

In all questions, active researchers were asked about the status of their departments, university management level was asked about the status of their organizations, and high level experts with advisory roles to STI policies were asked about the general status of Japanese universities.

Figure 2-2. List of questions and indices about young students aspiring to become researchers

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q105: Number of doctoral students with desirable competencies	2.4	3.3	2.4	2.1	2.1	2.7	2.0	2.8	2.4	2.6	-	2.1	2.5
Q106: Environmental arrangements for students to enter the doctoral program	4.2	4.9	4.6	3.8	3.8	4.2	4.3	4.2	4.2	4.4	-	4.3	3.5
Q107: Diversifying career paths for PhD holders	3.8	4.3	4.5	3.4	2.9	4.2	4.0	3.4	3.8	3.4	-	3.8	2.8

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q105: Number of doctoral students with desirable competencies	3.2	-	-	-	-	-
Q106: Environmental arrangements for students to enter the doctoral program	4.5	-	-	-	-	2.5
Q107: Diversifying career paths for PhD holders	4.2	-	-	-	-	2.5

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q105: Number of doctoral students with desirable competencies," the overall index for university natural science researchers among active researchers is 2.4 (perceived as significantly insufficient). By university group, Group 1 (3.3) and Group 3 and Group 4 (2.1) have a difference of 1.2 in the index. The index is 2.1 (perceived as significantly insufficient) for government priority programs researchers and 2.5 (perceived as strongly insufficient) for SSH researchers. Among experts (non-researchers), the index is 3.2 (perceived as strongly insufficient), which is 0.8 higher than the overall index of 2.4 for all university natural science researchers.

In "Q106: Environmental arrangements for students to enter the doctoral program," the overall index for university natural science researchers among active researchers is 4.2 (perceived as not sufficient). By university group, Group 1 (4.9) and Group 2 (4.6) and Group 3 and Group 4 (3.8) have differences of 1.1 and 0.8 in the index, respectively. The index is 4.3 (perceived as not sufficient) for government priority programs researchers and 3.5 (perceived as not sufficient) for SSH researchers. Among experts (non-researchers), the index is 4.5 (largely perceived as sufficient) for the university management level. High level experts with advisory roles to STI policies has an index of 2.5 (perceived as strongly insufficient). The index of 4.2 for all university natural science researchers is 1.7 higher than the index of 2.5 for high level experts with advisory roles to STI policies.

In "Q107: Diversifying career paths for PhD holders," the overall index for university natural science researchers among active researchers is 3.8 (perceived as not sufficient). By university group, Group 2 (4.5), Group 1 (4.3) and Group 4 (2.9) have differences of 1.6 and 1.4 in the index, respectively. By university department field, there is a 0.8 difference in the index between science (4.2) and health (3.4). The index is 3.8 (perceived as not sufficient) for government priority programs researchers and 2.8 (perceived as strongly insufficient) for SSH researchers. Among experts (non-researchers), the index is 4.2 (perceived as not sufficient) for the university management level. High level experts with advisory roles to STI policies has an index of 2.5 (perceived as strongly insufficient). Note that the index of 3.8 for all university natural science researchers is 1.3 higher than the index of 2.5 for high level experts with advisory roles to STI policies.

Based on the above, in the sub-category of young students aspiring to become researchers, the indices for "Environmental arrangements for students to enter the doctoral program (Q106)" and "Environmental arrangements for diversifying career paths for PhD holders (Q107)" are relatively high, however, many of the respondents group perceive as significantly insufficient for "the number of doctoral students with desirable abilities (Q105). The relatively high indices for Q106 and Q107 are also not at a sufficient level and are rated low by high level experts with advisory roles to STI policies. Furthermore, by university group, the index tends to be relatively high for universities with a large share of the number of papers (Group 1 and Group 2) and low for universities with the lower share of the number of papers (Group 3 and Group 4). The results suggest that there are differences in the situation among universities. The following comments are made on the open-ended questions concerning the sub-category: "There are few opportunities to obtain tenured positions after obtaining a PhD, so even if there are excellent students, we cannot encourage them to enter a doctoral program" and "Regarding career paths for young researchers, it would be desirable if career paths were not only in academia but also in other industries," suggesting that the environment for career paths for young researchers is

important. Another commented that "In order to increase the number of young researchers, the treatment of mid-career researchers, who are the future of young researchers, should be improved." In addition, regarding support for doctoral students, which has been increasing in recent years, some respondents stated that "support is insufficient," while others stated that "support has been increased or will be increased by the university to which the researcher belongs in recent years." Some respondents also commented that" a large-scale support framework has been launched, but the multiple systems are in disarray, making it difficult for students to understand."

Other issues raised in the open-ended comments regarding the sub-category are summarized as follows: "In order to increase the number of doctoral students, not only tuition waiver but also salary and scholarship are needed. It is desirable to be able to use the Grants-in-Aid for Scientific Research as a source of the funds," and "It is desirable to provide support for recurrent students regardless of their age in order to enhance the number of doctoral students."

1-3 Female researchers

In the sub-category of female researchers, the following three questions were asked to the active researchers and to the university management level and national institute management level among the experts (non-researchers). In addition, high level experts with advisory roles to STI policies among experts (non-researchers) were asked one question in Q109.

- ○ Q108: Do you think the number of female researchers is sufficient from the perspective of ensuring diversity among researchers?
- ○ Q109: Do you think there is sufficient support according to life stage so that more female researchers can play an active role?
- ○ Q110: Do you think there is sufficient devise of a human resources system for recruitment and promotion so that more female researchers can play an active role?

In all questions, active researchers were asked about the status of their departments, "university management level" and "national institute management level" were asked about the status of their organizations, and "high level experts with advisory roles to STI policies" were asked about the overall status of Japanese universities and national institutes.

Figure 2-3. List of questions and indices about female researchers

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q108: Number of female researchers (from the perspective of securing diversity of researchers)	3.4	3.3	3.5	3.6	3.3	2.6	2.9	4.3	3.4	3.5	3.9	3.1	4.4
Q109: Support for female researchers to play an active role	4.2	3.8	4.3	4.1	4.5	3.6	4.4	4.3	4.2	4.0	4.8	3.9	4.7
Q110: Developing a human resources system to enable female researchers to play an active role	4.8	4.8	4.4	4.9	5.1	4.4	5.0	4.7	5.0	4.1	5.1	4.4	5.4

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q108: Number of female researchers (from the perspective of securing diversity of researchers)	3.1	3.3	–	–	–	–
Q109: Support for female researchers to play an active role	4.8	5.1	–	–	–	2.6
Q110: Developing a human resources system to enable female researchers to play an active role	4.8	5.2	–	–	–	–

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q108: Number of female researchers (from the perspective of securing diversity of researchers)," the index for all natural science researchers at the university among active researchers is 3.4 (perceived as strongly insufficient). By university department field, the indices for health (4.3), science (2.6), and engineering/agriculture (2.9) differ by 1.7 and 1.4, respectively. The index for natural science researchers at national institutes is 3.9 (perceived as not sufficient), 3.1 for government priority programs researchers (perceived as strongly insufficient), and 4.4 for SSH researchers (perceived as not sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.1 (perceived as strongly insufficient) and 3.3 (perceived as strongly insufficient), respectively.

In "Q109: Support for female researchers to play an active role," the index for all natural science researchers at universities among active researchers is 4.2 (perceived as not sufficient). The index for natural science researchers at national research institutes is 4.8 (largely perceived as sufficient), 3.9 for government priority programs researchers (perceived as not sufficient), and 4.7 for SSH researchers (largely perceived as sufficient). Among experts (non-researchers), the indices are 4.8 (largely perceived as sufficient) and 5.1 (perceived as sufficient) for university management level and national institute management level. High level experts with advisory roles to STI policies has an index of 2.6 (perceived as strongly insufficient). The index of 4.2 for all university natural science researchers is 1.6 higher than the index of 2.6 for high level experts with advisory roles to STI policies.

In "Q110: Enabling a human resources system to female researchers to play an active role," the index for all natural science researchers at universities is 4.8 (largely perceived as sufficient). The index for natural science researchers at national research institutes is 5.1 (largely perceived as sufficient), 4.4 for government priority programs researchers (perceived as not sufficient), and 5.4 for SSH researchers (largely perceived as sufficient). Among experts (non-researchers), the indices are 4.8 (largely perceived as sufficient) and 5.2 (perceived as sufficient) for university management level and national institute management level. For the question, the index for female is 4.1 and male 5.0, a difference of 0.9 between them.

Based on the above, in the sub-category of female researchers, there is a relatively low evaluation of the number of female researchers, while a relatively high evaluation of the environmental improvement aspects, such as support for female researchers and developing a human resources system to enable female researchers to play an active role. In addition, while the overall difference between male and female researchers tended to be small, the "Developing a human resources system to enable female researchers to play an active role (Q110)" is rated low by female respondents. Although the small sample size does not allow for simple comparisons with other groups, SSH researchers tended to give higher ratings overall.

The following is a summary of the points of open-ended answers regarding the sub-category: "Instead of forcibly increasing the number of female researchers, we should increase the number of excellent female researchers. In doing so, attention should be paid to the differences in the population of each field," "Rather than trying to increase the number of female researchers employed, it may be more effective to encourage female students to enter graduate school," and "Especially under fixed-term employment, it is difficult to utilize support according to life events." Some of the opinions of female respondents included: "The system needs to

be improved, and education of upper-level workers is necessary to ensure that their awareness has not changed since they were young," and "Support for life events should cover not only female researchers but also their male partners and male researchers who are raising children on their own". In addition, there are comments such as, "For example, it is essential to expand systems such as those in other countries that allow employees to leave their posts for three years to take care of children or nursing care, and to create an atmosphere in the workplace that facilitates the use of such systems," and "It is important to realize that the life stages of women mentioned here also apply to men (not only women should be responsible for these stages)."

1-4 Foreign researchers

In the sub-category of foreign researchers, the following one question was asked to active researchers and university management level and national institute management level among experts (non-researchers).

○ Q111: Do you think that efforts to attract and retain outstanding foreign researchers are sufficient?

In the question, active researchers were asked about the status of their departments, and university management level and national institute management level were asked about the status of their organizations.

Figure 2-4. List of questions and indices about foreign researchers

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q111: Efforts to attract and retain outstanding foreign researchers	3.4	4.2	3.9	3.2	2.4	3.8	3.6	3.1	3.4	3.3	3.9	3.5	4.3

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q111: Efforts to attract and retain outstanding foreign researchers	3.4	4.3	–	–	–	–

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q111: Efforts to attract and retain outstanding foreign researchers," the index for university natural science researchers as a whole is 3.4 (perceived as strongly insufficient). By university group, Group 1 (4.2), Group 2 (3.9), and Group 4 (2.4) have a difference of 1.8 and 1.5 in the index, respectively. The index for natural science researchers at national institutes is 3.9 (perceived as not sufficient), 3.5 for government priority programs researchers (perceived as not sufficient), and 4.3 for SSH researchers (perceived as not sufficient). Among experts (non-researchers), the indices are 3.4 (perceived as strongly insufficient) and 4.3 (perceived as not sufficient) for university management level and national institute management level, respectively.

Based on the above, in the sub-category of foreign researchers, universities with a large share of the number of papers receive a relatively high evaluation of the status of efforts to attract and retain outstanding foreign researchers, while the evaluation tends to drop significantly for the universities with a smaller share. Although there is no difference of 0.8, which is the standard value used in this report to discuss difference, the relatively high evaluation in science and the relatively low evaluation in health suggest that there are differences among scientific fields. In addition, although the small sample size precludes a simple comparison with other groups, SSH researchers has relatively high ratings.

The following are some of the points raised in the open-ended answers regarding the sub-category: "Administrative procedures, etc., must be conducted in Japanese and the English proficiency of administrative

staff is limited, which increase the burden on faculty members," "It is difficult to hire outstanding foreign researchers when participation in work in Japanese is a prerequisite," and "It is important to incorporate not only foreign researchers but also Japanese researchers who are active in foreign countries."

1-5 Evaluation of researchers

In the sub-category of evaluation of researchers' performance, the following two questions were asked to active researchers and university management level and national institute management level among experts (non-researchers).

- ○ Q112: In the evaluation of researchers' performance, do you think that achievements/accomplishments other than papers (publication of books, education, social contribution, and so on) are also sufficiently evaluated?
- ○ Q113: Do you think that the results of evaluation of researchers are sufficiently reflected to the treatment of researchers (reflected in their salaries, positions and job titles, improvement of the research environment, granting of sabbaticals, etc.)?

In both questions, active researchers were asked about the status of their departments, and university management level and national institute management level were asked about the status of their organizations.

Figure 2-5. List of questions and indices for evaluation of researchers

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q112: Introducing multi-faceted evaluation of researchers	5.1	5.0	5.0	4.9	5.3	5.3	5.5	4.6	5.2	4.6	5.8	4.9	6.0
Q113: Treatment of researchers based on their evaluation	3.7	3.5	3.9	3.2	3.9	3.7	4.1	3.1	3.7	3.3	4.1	3.3	4.0

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q112: Introducing multi-faceted evaluation of researchers	5.9	6.2	–	–	–	–
Q113: Treatment of researchers based on their evaluation	4.6	5.4	–	–	–	–

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q112: Introducing multi-faceted evaluation of researchers," the index for university natural science researchers as a whole is 5.1 (largely perceived as sufficient). The index for natural science researchers at

national research institutes is 5.8 (perceived as sufficient), that for government priority programs researchers is 4.9 (largely perceived as sufficient), and that for SSH researchers is 6.0 (perceived as sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 5.9 (perceived as sufficient) and 6.2 (perceived as sufficient), respectively. The index for the university management level is 0.8 higher than that for all natural science researchers at universities.

In "Q113: Treatment of researchers based on their evaluation," the index for all university natural science researchers is 3.7 (perceived as not sufficient) among active researchers on their evaluation of researchers. By university department field, there is a 1.0 difference in the index between engineering and agriculture (4.1) and health (3.1). The index is 4.1 (perceived as insufficient) for natural science researchers at national institutes, 3.3 (perceived as strongly insufficient) for government priority programs researchers, and 4.0 (perceived as not sufficient) for SSH researchers. Among experts (non-researchers), the indices are 4.6 (largely perceived as sufficient) and 5.4 (perceived as sufficient) for university management level and national institute management level. Compared to natural science researchers at national institutes, the index for the university management level is 0.9 higher, and that for the national institute management level is 1.3 higher than that for natural science researchers at national institutes.

Based on the above, in the sub-category of evaluation of researchers' performance, there is a difference in perception between the entire natural science researchers of universities and the university management level in both questions of "Introducing multi-faceted evaluation of researchers (Q112)" and "Treatment of researchers based on their evaluation (Q113)," and the latter is higher than the former. In particular, for "Treatment of researchers based on their evaluation (Q113)," the index for university natural science researchers as a whole is lower than that of the university management level, indicating a difference between the two groups' perceptions. The reasons for this difference in perception may be that the efforts of the university management level are not satisfactory for researchers, and that researchers do not see how the results of evaluation of researchers conducted by the university management level are used. The following are a summary of the issues raised in the open-ended comments regarding the sub-category: "Appropriate methods are not being used to evaluate research performance, such as using only the number of papers as an indicator," "Diversification of evaluation targets is needed, such as evaluating education and social contributions based on the original nature of universities as educational institutions," and "How evaluation is conducted in universities and departments is not clear to researchers in the field." Comparing the indices for "Introducing multi-faceted evaluation of researchers (Q112)" and "Treatment of researchers based on their evaluation (Q113)" by attribute, the index for the latter is lower overall. This suggests that, compared to "Introducing multi-faceted evaluation of researchers" (Q112), the problem is perceived to be in the stage of utilizing the results of evaluation of researchers.

Other issues raised in the open-ended answers regarding the classification include: "Even if a researcher achieves results in terms of publishing papers or obtaining research funds, these are not reflected in the treatment," "The fairness of evaluation is hindered by the evaluator's personal policy, the evaluator's tenure, and other conditions," and "The seemingly fair evaluation based on the same criteria hinders fairness among the fields."

2 Research Environment

The research environment part consists of sub-categories of "research resources," "research facilities and equipment," and "transformation of research activities." The Basic Plan seeks to promote efforts to secure research time and improve research facilities and equipment in order to "rebuild an environment that generates diverse and outstanding research." In addition, for the "establishment of a new research system (promotion of open science and data-driven research, etc.)," it describes efforts to develop infrastructure and build an environment that will support the transformation of research activities associated with the development of new technologies such as AI and virtual technologies. In this part, we will grasp the status of the research environment in which researchers at universities, national research institutes, etc. are placed from the aspect of general importance, such as status of information infrastructure for research, research funds, time for research, and research facilities and equipment, as well as from the aspect of the transformation of research activities that is currently underway at a rapid pace.

2-1 Research resources

In the sub-category of research resources, the following five questions were asked to active researchers and to university management level, national institute management level, and companies among the experts (non-researchers). Q202 and Q203 were asked to also high level experts with advisory roles to STI policies.

- ○ Q201: Do you think the status of information infrastructure for research* is sufficient?
  *Information infrastructure for research: university libraries, access to research information such as papers, data platforms, research information networks
- ○ Q202: Do you think the current recurrent or block grant funding (internal research funds of the institution, etc.) is sufficiently secured to carry out the basic activities regarding R&D?
- ○ Q203: Do you think competitive and other public funding are sufficiently available for researchers for their research activities?
- ○ Q204: Do you think efforts to secure research time for researchers are sufficient (e.g., devising organizational management, securing research supporting staff, using digital tools, and so on)?
- ○ Q205: Do you think that developing or securing specialists in research management (e.g., research administrators) is sufficient for the smooth management of research activities?

Active researchers were asked about the overall situation in Japan in their field of research in Q201, and about the situation in their departments in the other questions. University management level and national institute management level were asked about the situation in Japan as a whole in Q201, and about their affiliated organization in the other questions. Companies were asked about the situation in Japan as a whole in Q201, and about the situation of their related Japanese universities and national research institutes in the other questions. High level experts with advisory roles to STI policies were asked about the general situation of Japanese universities and national research institutes in all questions.

Figure 2-6. List of questions and indices about research resources

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q201: Status of information infrastructure for research	5.0	5.4	5.3	4.9	4.5	5.1	5.0	5.0	5.0	5.0	4.9	4.6	5.0
Q202: Securing recurrent or block grant funding	3.6	3.8	3.2	3.3	4.1	3.6	3.6	3.6	3.5	4.1	4.4	3.2	4.4
Q203: Securing competitive funding	4.8	5.1	5.2	4.6	4.4	4.7	4.8	4.8	4.8	4.8	5.2	5.4	6.0
Q204: Efforts to secure research time	2.8	3.2	2.8	2.5	2.6	2.9	2.7	2.8	2.7	2.8	3.2	3.1	3.3
Q205: Developing or securing specialists in research management	2.7	3.0	3.0	2.6	2.2	2.7	2.8	2.6	2.7	2.4	2.7	2.9	2.6

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q201: Status of information infrastructure for research	3.5	3.7	3.4	3.7	3.3	–
Q202: Securing recurrent or block grant funding	3.7	3.5	2.2	2.7	2.1	2.2
Q203: Securing competitive funding	4.1	4.8	2.6	2.9	2.5	3.9
Q204: Efforts to secure research time	3.4	4.3	2.2	3.2	2.0	–
Q205: Developing or securing specialists in research management	3.3	3.4	2.3	2.7	2.2	–

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

Note 3: For all of the questions, respondents from companies were asked about the status of universities, national research institutes, etc. known to them. For example, "Securing recurrent or block grant funding (Q202)" is a question about the recurrent or block grant funding of universities and national research institutes, not about the recurrent funding of companies.

In "Q201: Status of information infrastructure for research," the index for all university natural science researchers is 5.0 (largely perceived as sufficient) among active researchers. By university group, Group 1 (5.4), Group 2 (5.3), and Group 4 (4.5) have a difference of 0.9 and 0.8 in the index, respectively. The index for natural science researchers at national institutes is 4.9 (largely perceived as sufficient), for government priority programs researchers is 4.6 (largely perceived as sufficient), and for SSH researchers is 5.0 (largely perceived as sufficient). Among experts (non-researchers), the indices for university management level and

national institute management level are 3.5 (perceived as not sufficient) and 3.7 (perceived as not sufficient). The index for all companies is 3.4 (perceived as strongly insufficient), for large companies 3.7 (perceived as not sufficient), and for SMEs and university ventures 3.3 (perceived as strongly insufficient). There is a 1.5 difference between the index of 5.0 for all university natural science researchers and 3.5 for the university management level. There is a 1.2 difference in the index between natural science researchers at national institutes and management level.

In "Q202: Securing recurrent or block grant funding," the overall index for university natural science researchers among active researchers is 3.6 (perceived as not sufficient). By university group, Group 4 (4.1) and Group 2 (3.2) and Group 3 (3.3) have differences of 0.9 and 0.8 in the index, respectively. The index for natural science researchers at national institutes is 4.4 (perceived as not sufficient), 3.2 for government priority programs researchers (perceived as strongly insufficient), and 4.4 for SSH researchers (perceived as not sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.7 (perceived as not sufficient) and 3.5 (perceived as not sufficient), respectively. The index for all companies is 2.2 (perceived as significantly insufficient), for large companies 2.7 (perceived as strongly insufficient), and for SMEs and university ventures 2.1 (perceived as significantly insufficient). For high level experts with advisory roles to STI policies, the index is 2.2 (perceived as significantly insufficient). Note that the index of 3.6 for university natural science researchers as a whole is 1.4 higher than the index of 2.2 for the firms as a whole and for high level experts with advisory roles to STI policies.

In "Q203: Securing competitive funding, etc.," the index for all university natural science researchers is 4.8 (largely perceived as sufficient) among active researchers. The index is 5.2 (largely perceived as sufficient) for national institutes of natural sciences, and 5.4 (largely perceived as sufficient) for government priority program researchers. The index for natural science researchers at national research institutes is 5.2 (perceived as sufficient), 5.4 for government priority programs researchers (perceived as largely sufficient), and 6.0 for SSH researchers (perceived as sufficient). University management level and national institute management level among experts (non-researchers), the indices are 4.1 (perceived as not sufficient) and 4.8 (largely perceived as sufficient). The index for companies as a whole is 2.6 (perceived as strongly insufficient), for large companies 2.9 (perceived as strongly insufficient), and for SMEs and university ventures 2.5 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.9 (perceived as not sufficient). Note that the index of 4.8 for all university natural science researchers is 2.2 and 0.9 higher than the index of 2.6 for all firms and 3.9 for high level experts with advisory roles to STI policies, respectively.

In "Q204: Efforts to secure research time," the index for all university natural science researchers is 2.8 (perceived as strongly insufficient) among active researchers. The index for natural science researchers at national research institutes is 3.2 (perceived as strongly insufficient), 3.1 for government priority programs researchers (perceived as strongly insufficient), and 3.3 for SSH researchers (perceived as strongly insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.4 (perceived as strongly insufficient) and 4.3 (perceived as sufficient), respectively. There is a 1.1 difference in the index between the national institute management level and natural science researchers at national institutes. The index for all companies is 2.2 (perceived as significantly insufficient), for large companies 3.2 (perceived as strongly insufficient), and for SMEs and university ventures 2.0 (perceived

as significantly insufficient). There is a 1.0 difference between the index of 3.2 for natural science researchers at national institutes and 2.2 for all companies.

In "Q205: Developing or securing specialists in research management," the index for all university natural science researchers is 2.7 (perceived as strongly insufficient) among active researchers. By university Group 1 and Group 2 (both 3.0) and Group 4 (2.2), there is a 0.8 difference in the index. The index for natural science researchers at national institutes is 2.7 (perceived as strongly insufficient), 2.9 for government priority programs researchers (perceived as strongly insufficient), and 2.6 for SSH researchers (perceived as strongly insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.3 (strongly perceived as insufficient) and 3.4 (strongly perceived as insufficient), respectively. The index for all companies is 2.3 (perceived as significantly insufficient), for large companies 2.7 (strongly perceived as insufficient), and for SMEs and university ventures 2.2 (perceived as significantly insufficient).

Based on the above, in the sub-category of research resources, the respondents perceived "Status of information infrastructure for research (Q201)" and "Securing or block grant funding (Q203)" as largely sufficient, but the index for "Securing recurrent or block grant funding (Q202)" is relatively low, and the index for "Efforts to secure research time (Q204)" and "Securing management professionals (Q205)" are strongly perceived as insufficient. In the comparison of Q202 by university group, Group 2 and Group 3, which are positioned in the middle in terms of the share of the number of papers, show low indices. In the case of "Developing or securing specialists in research management (Q205)," Group 4 has a low index. In addition to the low scores of active researchers and university management level and national institute management level, the indices of companies and high level experts with advisory roles to STI policies tended to be even lower in the questions with low indices. The following are a summary of the issues raised in the open-ended answers regarding the same classification: "Due to the shortage of technical and administrative staff, the scope of researchers' duties has expanded, leading to a decrease in research time," "The more competitive funds are obtained, the more time is spent on documents for obtaining funds, management of obtained funds, and report writing, etc., leading to a decrease in research time," and "Financial constraints make it difficult to hire administrative assistants in the laboratories." Although the small sample size precluded simple comparison with other groups, SSH researchers tended to have relatively high indices for "Securing recurrent or block grant funding (Q202)" and "Securing competitive funding (Q203).

Other issues in the open-ended answers regarding the same sub-category are summarized as follows: "There is a disparity in access to articles among universities," and "Organizational support should be provided for publication fees, which are becoming increasingly expensive with the shift to open access.

2-2 Research facilities and equipment

In the sub-category of research facilities and equipment, the following three questions were asked to active researchers and university management level and national institute management level among experts (non-researchers). In addition, two questions, Q206 and Q208, were asked of "companies" among the experts (non-researchers).

○ Q206: Do you think the level of research facilities and equipment is sufficient to conduct creative and advanced R&D and develop outstanding human resources?

○ Q207: Do you think there are sufficient sharing systems of research facilities, equipment, and instruments within the organization?

○ Q208: Do you think the level of accessibility (procedures, support system, fees, etc.) of shared research facilities and equipment owned by universities and public research institutes is sufficient?

In Q206 and Q207, active researchers were asked about the status of their departments, and university management level and national institute management level were asked about the status of their organizations. In Q208, active researchers were asked about general situation of Japan in their research field and university management level and national institute management level were asked about the general situation in Japan. For companies, Q206 asked about the situation of Japanese universities and national research institutes that they know, and Q208 asked about the general situation in Japan.

Figure 2-7. List of questions and indices about research facilities and equipment

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q206: Level of research facilities and equipment	4.6	5.6	4.9	4.1	4.1	4.9	4.7	4.4	4.6	4.6	5.5	4.9	4.3
Q207: Sharing system of research facilities, equipment, and instruments within the organization	5.3	5.9	5.7	5.1	4.6	5.8	5.2	5.3	5.3	5.2	5.7	5.3	4.5
Q208: Accessibility of shared research facilities and equipment outside the organization	4.7	5.4	4.8	4.7	4.0	5.1	4.6	4.5	4.6	4.7	5.3	4.7	4.7

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q206: Level of research facilities and equipment	4.6	5.3	3.3	3.8	3.2	–
Q207: Sharing system of research facilities, equipment, and instruments within the organization	5.2	6.5	–	–	–	–
Q208: Accessibility of shared research facilities and equipment outside the organization	3.9	5.2	3.2	3.9	3.1	–

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q206: Level of research facilities and equipment," the index for all university natural science researchers is 4.6 (largely perceived as sufficient) among active researchers. By university group, there is a 1.5 difference

in the index between Group 1 (5.6) and Group 3 and Group 4 (both 4.1), and a 0.8 difference between Group 2 (4.9) and Group 3 and Group 4. The index is 5.5 (perceived as sufficient) for natural science researchers at national research institutes, 4.9 (largely perceived as sufficient) for government priority programs researchers, and 4.3 (perceived as insufficient) for SSH researchers. Among experts (non-researchers), the indices for university management level and national institute management level are 4.6 (largely perceived as sufficient) and 5.3 (largely perceived as sufficient), respectively. The index for all companies is 3.3 (perceived as strongly insufficient). By type of company, the index is 3.8 (perceived as not sufficient) for large companies and 3.2 (perceived as strongly insufficient) for SMEs and university ventures. Note that the index for university natural science researchers as a whole is 0.9 lower than that for natural science researchers at national institutes. The indices for university natural science researchers as a whole and natural science researchers at national institutes are 1.3 and 2.2 higher for the former and the latter, respectively, than those for all firms.

In "Q207: Sharing system of research facilities, equipment, and instruments within the organization," the index for all university natural science researchers is 5.3 (largely perceived as sufficient) among active researchers in research facilities, equipment, and instruments within the organization. By university group, there is a difference of 0.8 and 1.3 in the indices for Group 3 (5.1) and Group 4 (4.6) compared to Group 1 (5.9), respectively. There is also a difference of 1.1 in the index between Group 2 (5.7) and Group 4. The index is 5.7 (perceived as sufficient) for natural science researchers at national institutes, 5.3 (largely perceived as sufficient) for government priority programs researchers, and 4.5 (largely perceived as sufficient) for SSH researchers. Among experts (non-researchers), the indices for university management level and national institute management level are 5.2 (largely perceived as sufficient) and 6.5 (perceived as sufficient), with the former being 1.3 lower than the latter. While there is no difference in the perception of natural science researchers at universities and university management level, the index for the natural science researchers at national institutes is 0.8 lower than that of their management level.

In "Q208: Level of accessibility of shared research facilities and equipment outside the organization," the index for all university natural science researchers is 4.7 (largely perceived as sufficient) among active researchers. By university group, Group 1 (5.4) and Group 4 (4.0) have a difference of 1.4 in the index. The index for natural science researchers at national institutes is 5.3 (largely perceived as sufficient), that for government priority programs researchers is 4.7 (largely perceived as sufficient), and that for SSH researchers is 4.7 (largely perceived as sufficient). Among experts (non-researchers), the indices are 3.9 (perceived as not sufficient) and 5.2 (largely perceived as sufficient) for the university management level and national institute management level, with the former having a lower index of 1.3 than the latter. The index for all companies is 3.2 (perceived as strongly insufficient), for large companies 3.9 (perceived as not sufficient), and for SMEs and university ventures 3.1 (perceived as strongly insufficient). Note that the overall index for university natural science researchers is 1.5 higher than the index for companies as a whole.

Based on the above, in the sub-category of research facilities and equipment, differences in perception were observed by university group in all questions of "Level of research facilities and equipment (Q206)," "Sharing system of research facilities, equipment, and equipment within the organization (Q207)," and "Accessibility of shared research facilities and equipment outside the organization (Q208)." In particular, Group 4 tends to have a lower index than Group 1 and Group 2. This suggests that the condition of research facilities and equipment

is relatively poor for universities with a small share of the total number of papers (Group 4G). Regarding ″Level of research facilities and equipment (Q206)″ and ″Accessibility of shared research facilities and equipment outside the organization (Q208),″ the active researchers and those in the university management level and national institute management level, both of which are inside the research organization, generally perceive the facilities and equipment to be sufficient. While those from the outside, such as companies, perceive it as strongly insufficient as a whole. In particular, SMEs and university ventures perceive as strongly insufficient. This suggests that the level of research facilities and equipment at Japanese universities and national research institutes is not high enough for SMEs and university ventures, and that it is difficult for them to use them.

The issues raised in the open-ended answers regarding the sub-category are as follows: ″It is difficult to use shared research facilities and equipment outside the organization due to lack of support, funds, and manpower,″ ″It takes time to submit many forms when using shared facilities,″ and ″ Even if there are shared facilities, they cannot be fully utilized due to the lack of dedicated laboratory assistants and personnel for maintenance and management.”

2-3 Transformation of research activities

In the sub-category of the transformation of research activities, the following five questions were asked to active researchers. Among experts (non-researchers), university management level, national institute management level, and companies were asked four questions from Q209 to Q212. Two questions (Q211 and Q212) were asked to high level experts with advisory roles to STI policies.

- ○ Q209: Do you think that the transformation of research methods based on ICT technology (automation, use of AI, use of virtual space, data-driven research, and so on) is sufficiently advanced?
- ○ Q210: Do you think the activities in research exchange, education, and so on are sufficiently going remote?
- ○ Q211: Do you think efforts to open and share research data and publications based on public research funding* are sufficient?

  Developing data policies, building and using data repositories, supporting for opening data and publications, and so on.
- ○ Q212: Do you think the utilization of open / shared research data and publications is sufficient?
- ○ Q213: Do you think that there is sufficient progress in diversifying methods of publishing research outputs (e.g., opening data, using preprints, and so on)?

In Q209 and Q210, active researchers were asked about the status of their departments, university management level and national institute management level were asked about the status of their organizations, and companies were asked about the status of their related Japanese universities and national research institutes. In Q211 and Q212, active researchers were asked about the general situation in Japan in their own research field, and university management level, national institute management level, company, and high level experts with advisory roles to STI policies were asked about the general situation in Japan. In Q213, active researchers were asked about the general situation in Japan in their field of research.

Figure 2-8. List of questions and Indices on transformation of research activities

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q209: Progress in transforming research methodologies based on ICT technologies	3.3	3.9	3.5	2.9	3.0	3.5	3.7	2.7	3.3	3.0	4.5	3.2	3.0
Q210: Going remote in research exchange, education, etc.	6.3	6.3	6.9	5.9	6.0	6.6	6.6	5.8	6.4	5.8	6.7	6.1	6.7
Q211: Efforts to open research data and publications	5.3	5.5	5.5	4.9	5.3	5.5	5.4	5.0	5.3	5.3	5.5	4.8	5.3
Q212: Using open research data and publications	4.7	5.1	4.8	4.4	4.5	4.9	4.8	4.5	4.7	4.6	5.0	4.4	4.6
Q213: Diversification of methods for publishing research outputs	4.9	5.2	5.0	4.8	4.7	5.5	5.0	4.6	4.9	4.8	5.0	4.6	4.5

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q209: Progress in transforming research methodologies based on ICT technologies	3.2	4.1	2.7	3.2	2.6	–
Q210: Going remote in research exchange, education, etc.	5.6	6.0	4.5	5.6	4.2	–
Q211: Efforts to open research data and publications	3.9	5.1	3.8	4.3	3.7	3.7
Q212: Using open research data and publications	3.5	4.0	2.8	3.3	2.7	2.9
Q213: Diversification of methods for publishing research outputs	–	–	–	–	–	–

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q209: Progress in transforming research methodologies based on ICT technology," the index for natural science researchers at universities among active researchers is 3.3 (perceived as strongly insufficient). By university group, the difference in indices for Group 1 (3.9) and Group 3 (2.9) and Group 4 (3.0) are 1.0 for and 0.9, respectively. By scientific field, the indices for science (3.5) and engineering/agriculture (3.7) compared to health (2.7) differed by 0.8 for the former and 1.0 for the latter. The index for natural science researchers at national institutes is 4.5 (largely perceived as sufficient), while the index for government priority programs researchers is 3.2 (perceived as strongly insufficient) and 3.0 (perceived as not sufficient) for SSH researchers. Among experts (non-researchers), the indices for university management level and national institute management level are 3.2 (perceived as strongly insufficient) and 4.1 (perceived as not sufficient), respectively. The index for all companies is 2.7 (perceived as strongly insufficient), for large companies 3.2 (perceived as strongly insufficient), and for SMEs and university ventures 2.6 (perceived as strongly insufficient). The index for natural science researchers at national institutes is 1.2 higher than that for university natural science researchers as a whole, and the index for national institute management level is 0.9 higher than that for university management level. The index for natural science researchers at national institutes is 1.8 higher than that for companies as a whole.

In "Q210: Going remote in research exchange, education, etc.," among active researchers, the overall index for university natural science researchers is 6.3 (perceived as sufficient). By university group, Group 2 (6.9), Group 3 (5.9), and Group 4 (6.0), the indices differed by 1.0 and 0.9, respectively. By university department field, there is a difference of 0.8 in the index between science (6.6), engineering/agriculture (6.6) and health (5.8). The index for natural science researchers at national research institutes is 6.7 (perceived as sufficient), 6.1 (perceived as sufficient) for government priority programs researchers, and 6.7 (perceived as sufficient) for SSH researchers. Among experts (non-researchers), the indices for university management level and national

institute management level are 5.6 (perceived as sufficient) and 6.0 (perceived as sufficient), respectively. The index for all companies is 4.5 (largely perceived as sufficient), for large companies (5.6) (perceived as sufficient), and for SMEs and university ventures (4.2) (perceived as not sufficient). Compared to companies as a whole, the indices for university natural science researchers and natural science researchers at national institutes are 1.8 and 2.2 higher for the former and latter, respectively.

In ″Q211: Efforts to open research data and publications,″ the index for all university natural science researchers among active researchers is 5.3 (largely perceived as sufficient). The index for natural science researchers at national research institutes is 5.5 (perceived as sufficient), that for government priority programs researchers is 4.8 (largely perceived as sufficient), and that for SSH researchers is 5.3 (largely perceived as sufficient). Among experts, university management level and national institute management level have the indices of 3.9 (perceived as not sufficient) and 5.1 (largely perceived as sufficient), respectively. The index for companies as a whole is 3.8 (perceived as not sufficient), for large companies 4.3 (perceived as not sufficient), and for SMEs and university ventures 3.7 (perceived as not sufficient). For high level experts with advisory roles to STI policies, the index is 3.7 (perceived as not sufficient). Compared to high level experts with advisory roles to STI policies, the index for natural science researchers at universities and those at national institutes are higher for 1.6 and for 1.8, respectively. Compared to the university management level, the index for the national institute management level is 1.2 higher.

In “Q212: Using open research data and publications,” the index for all university natural science researchers among active researchers is 4.7 (largely perceived as sufficient). The index for natural science researchers at national research institutes is 5.0 (largely perceived as sufficient), that for government priority programs researchers is 4.4 (perceived as not sufficient), and that for SSH researchers is 4.6 (largely perceived as sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.5 (perceived as not sufficient) and 4.0 (perceived as not sufficient), respectively. The index for all companies is 2.8 (perceived as strongly insufficient), for large companies 3.3 (perceived as strongly insufficient), and for SMEs and university ventures 2.7 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 2.9 (perceived as strongly insufficient). Compared to natural science researchers at universities as a whole, the index for the university management level is 1.2 lower, and compared to natural science researchers at national institutes, the index for the national institute management level is 1.0 lower. Compared to the entire company, the indices for university natural science researchers as a whole and natural science researchers at national institutes are 1.9 and 2.2 higher, respectively. Compared to high level experts with advisory roles to STI policies, the indices for natural science researchers at universities and those at national institutes are 1.8 and 2.1 higher, respectively.

In ″Q213: Diversification of methods for publishing research outputs,″ the index for all university natural science researchers among active researchers is 4.9 (largely perceived as sufficient). By university department field, the difference between the indices for science (5.5) and health (4.6) is 0.9. The index for natural science researchers at national institutes is 5.0 (largely perceived as sufficient), that for government priority programs researchers is 4.6 (largely perceived as sufficient), and that for SSH researchers is 4.5 (largely perceived as sufficient).

Based on the above, in the sub-category of transforming research activities, university natural science researchers have a low index only for "Progress in transforming research methodologies based on ICT technology (Q209)" when compared to the other questions. Furthermore, the indices for Group 3 and Group 4 are lower than those for Group 1. While the index for "Progress in transforming research methodologies based on ICT technology (Q209)" is relatively high for natural science researchers at national research institutes. This indicates that the reform of research methods based on ICT technology is relatively lagging behind especially among universities with a small share of the total number of papers, while it is relatively advanced among national research institutes. Regarding "Going remote in research exchange, education, etc. (Q210)", all university groups have high indices. Many respondents stated that "the spread of the COVID-19 infection triggered the shift to remote research," and that "the importance of creating a system that allows researchers to work flexibly increases, due to the time difference and other issues involved in conducting joint research with researchers from all over the world remotely."

In both "Efforts to open research data and publications (Q211)" and "Using open research data and publications (Q212)," in which respondents with high level experts to advisory roles to STI policies are included, university natural science researchers as a whole and natural science researchers at national research institutes have higher indices than those high level experts. The reason for the difference in perception is that, for example, while researchers answered the question within the scope related to their research activities, those high-level experts answered that research data is not being disclosed and shared in terms of availability in sectors other than research institutions, such as industry and government.

Other issues raised in the open-ended answers in the sub-category include: "When introducing ICT technology, there are issues such as the fact that everyone cannot learn to use it without organizational support and that the organizational environment is not compatible with the new technology," "There are issues such as the need for continuous funding for the development of data publication/sharing infrastructure," and "With regard to data publication and sharing, there are concerns about the low quality of data that have not been peer-reviewed and the increased workload of researchers, which puts pressure on their research time."

3 Research Activities and Research Support

The part on research activities and support consists of sub-categories of "academic research and basic research" and "government research fund management. The Basic Plan describes efforts to promote academic research and basic research in order to "rebuild an environment that generates diverse and outstanding research." The purpose of this part is to grasp the status of the promotion of academic research and basic research, as well as the status of the government's efforts to allocate funds to support such research. In relation to the latter, since the support by recurrent or block grant funding is asked in the sub-category of "research resources" in the part on research environment, this section focuses mainly on the support through funding agencies.

3-1 Academic research and basic research

In the academic research and basic research sub-category, all respondents in the group of active researchers and experts (non-researchers) were asked the following four questions.

- ○ Q301: Do you think that the researchers in Japan sufficiently have the opportunities for exploring new themes and conducting challenging research based on intrinsic motivation*?
  *Support through Grants-in-Aid for Scientific Research and other financial resources, a climate that encourages exploratory and challenging research, and so on.
- ○ Q302: Do you think that the diversity in basic research in Japan is sufficiently ensured?
- ○ Q303: Do you think that internationally outstanding results in basic research are sufficiently produced?
- ○ Q304: Do you think the results of R&D in Japan are sufficiently led to innovation?

In either questions, active researchers were asked about the general situation in Japan in their own research field, and experts (non-researchers) were asked about the general situation in Japan.

Figure 2-9. List of questions and indices for academic research and basic research

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q301: Environment for exploring new themes and conducting challenging research	3.5	3.6	3.7	3.3	3.6	3.6	3.6	3.5	3.5	4.0	3.9	3.6	4.1
Q302: Diversity in basic research	3.3	3.1	3.3	3.4	3.4	3.2	3.3	3.4	3.3	3.5	2.9	3.2	3.3
Q303: Internationally outstanding achievements in basic research	3.3	3.4	3.4	3.3	3.3	3.9	3.3	3.1	3.3	3.3	3.4	3.3	2.5
Q304: Connecting R&D results to innovation	3.3	3.4	3.2	3.3	3.4	3.6	3.3	3.2	3.3	3.5	3.6	3.1	3.0

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q301: Environment for exploring new themes and conducting challenging research	3.8	4.2	2.6	3.2	2.4	3.4
Q302: Diversity in basic research	3.0	3.3	2.8	3.4	2.7	3.3
Q303: Internationally outstanding achievements in basic research	3.1	3.4	2.5	3.2	2.3	3.0
Q304: Connecting R&D results to innovation	3.2	3.2	2.5	3.2	2.3	2.9

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q301: Environment for exploring new themes and conducting challenging research," the index for all university natural science researchers among active researchers is 3.5 (perceived as not sufficient). The index for natural science researchers at national research institutes is 3.9 (perceived as not sufficient), 3.6 for government priority programs researchers (perceived as insufficient), and 4.1 for SSH researchers (perceived as not sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.8 (perceived as not sufficient) and 4.2 (perceived as not sufficient), respectively. The index for all companies is 2.6 (perceived as strongly insufficient), 3.2 (perceived as strongly insufficient) for large companies, and 2.4 (perceived as significantly insufficient) for SMEs and university ventures. For high level experts with advisory roles to STI policies, the index is 3.4 (perceived as strongly insufficient). Compared to the index of 3.5 for all university natural science researchers, the index of 2.6 for all firms is 0.9 lower.

In "Q302: Diversity in basic research," among active researchers, the index for all natural science

researchers at universities is 3.3 (perceived as strongly insufficient). The index for natural science researchers at national research institutes is 2.9 (perceived as strongly insufficient), 3.2 for government priority programs researchers (perceived as strongly insufficient), and 3.3 for SSH researchers (perceived strongly as insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.0 (perceived as strongly insufficient) and 3.3 (perceived as strongly insufficient), respectively. The index for all companies is 2.8 (perceived as strongly insufficient), for large companies 3.4 (perceived as strongly insufficient), and for SMEs and university ventures 2.7 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.3 (perceived as strongly insufficient). Overall, there are no significant differences in the index among the respondent groups for the question item.

In "Q303: Internationally outstanding achievements in basic research," the overall index for university natural science researchers among active researchers is 3.3 (perceived as strongly insufficient). By university department field, there is a 0.8 difference in the index between science (3.9) and health (3.1). The index for natural science researchers at national institutes is 3.4 (perceived as strongly insufficient), 3.3 for government priority programs researchers (strongly perceived as insufficient), and 2.5 for SSH researchers (perceived as strongly insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.1 (strongly perceived as insufficient) and 3.4 (perceived as strongly insufficient), respectively. The index for all companies is 2.5 (perceived as strongly insufficient), 3.2 (perceived as strongly insufficient) for large companies, and 2.3 (perceived as significantly insufficient) for SMEs and university ventures. For high level experts with advisory roles to STI policies, the index is 3.0 (perceived as strongly insufficient).

In "Q304: Connecting R&D results to innovation," the index for all university natural science researchers among active researchers is 3.3 (perceived as strongly insufficient). The index for natural science researchers at national institutes is 3.6 (perceived as insufficient), 3.1 for government priority programs researchers (strongly perceived as insufficient), and 3.0 for SSH researchers (strongly perceived as insufficient). Among experts (non-researchers), the index is 3.2 (perceived as strongly insufficient) for both university management level and national institute management level. The index for all companies is 2.5 (perceived as strongly insufficient), for large companies 3.2 (perceived as strongly insufficient), and for SMEs and university ventures 2.3 (perceived as significantly insufficient). For high level experts with advisory roles to STI policies, the index is 2.9 (perceived as strongly insufficient).

Based on the above, in the sub-category of academic research and basic research, for all the questions on "Environment for exploring new themes and conducting challenging research (Q301)," "Diversity in basic research (Q302)," "Internationally outstanding achievements in basic research (Q303)," and "Connecting R&D results to innovation (Q304)", the index tended to be low overall. Almost all questions were characterized by uniformly low indices, with no significant differences in indices among university groups or university departmental areas. In addition, the indices for all attributes in all questions are less than 4.5, which is a sub-category with particularly strong perceptions as strongly insufficient. However, in "Internationally outstanding achievements in basic research (Q303)," the respondents in science field has a relatively high index, suggesting

that this may reflect the characteristics of the field[1], which has many research themes originally require international collaboration. In summarizing the issues raised in the free comments related to the sub-category, several respondents stated that "Through the selection and concentration of research funds, funds are concentrated on short-term or promising research, resulting in a loss of diversity in research," and "In order to enable exploratory research based on free ideas, it is necessary to expand basic research funds such as the subsidy for operating expenses, etc."

Other opinions include: "The size of the research fund is not appropriate from the perspective of effectively conducting the research (too large or too small), " "Without increasing the rate of Grants-in-Aid for Scientific Research adoption and coverage, it will not be possible to conduct the planned research," "The usability of research funds is being reduced due to restrictions on the use of funds and the fiscal year in which they are used," "The unstable research environment limits the range of research theme choices for researchers," and "While research programs to support young researchers have been enhanced, support for mid-career researchers has become less generous."

[1] This may be reflected in the high index of science in "International collaboration in science and technology (see Q612).

3-2 Government research funding management

In the sub-category of government research fund management, the following five questions were asked to active researchers and university management level and national institute management level among experts (non-researchers). In addition, two questions, Q305 and Q309, were asked to high level experts with advisory roles to STI policies.

- ○ Q305: Do you think that the funding agencies (JSPS, JST, AMED, NEDO, and so on) are sufficiently fulfilling the functions according to their roles, such as supporting challenging research and strategically allocating funds?
- ○ Q306: Do you think that sufficient efforts are being made for securing research funding for competent mid-level and above researchers in a stable and sufficient manner?
- ○ Q307: Do you think the usability of government public research funding is sufficient (e.g., appropriate amount, flexible use, secured time frame, etc.)?
- ○ Q308: Do you think the method and frequency of interim- and post-evaluations of government public research funding are sufficiently appropriate?
- ○ Q309: Do you think that the diversification of perspectives for research project evaluation* has made sufficient progress?

  Challenging initiatives, unanticipated results, economic and social effects, and so on.

In either question, active researchers were asked about the general situation in Japan in their own research field, and experts (non-researchers) were asked about the general situation in Japan.

Figure 2-10. List of questions and indices on government research funding management

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q305: Functions according to the role of the funding organization	4.3	4.3	3.9	4.3	4.6	4.2	4.3	4.3	4.3	4.4	4.3	4.7	4.4
Q306: Securing research funding for competent mid-level and above researchers	3.3	3.4	3.1	3.2	3.6	3.4	3.7	2.9	3.3	3.6	3.4	3.5	4.1
Q307: Accessibility of government public research funding	3.7	3.2	3.4	3.9	4.1	3.6	3.8	3.6	3.7	3.7	3.2	3.2	3.7
Q308: Content and frequency of interim- and post-evaluations of government public research funding	5.1	5.0	5.0	4.8	5.5	5.4	5.3	4.8	5.1	5.2	5.0	5.0	5.2
Q309: Diversification of perspectives for research project evaluation	3.9	3.9	4.0	3.9	3.9	3.9	3.9	3.8	3.9	4.0	4.1	3.9	4.5

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q305: Functions according to the role of the funding organization	 4.6	 5.1	–	–	–	 4.3
Q306: Securing research funding for competent mid-level and above researchers	 3.6	 3.9	–	–	–	–
Q307: Accessibility of government public research funding	 3.5	 3.8	–	–	–	–
Q308: Content and frequency of interim- and post-evaluations of government public research funding	 4.4	 4.3	–	–	–	–
Q309: Diversification of perspectives for research project evaluation	 3.8	 3.8	–	–	–	 3.3

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q305: Functions according to the role of the funding organization," the index for all university natural science researchers among active researchers is 4.3 (perceived as not sufficient). The index for natural science researchers at national research institutes is 4.3 (perceived as not sufficient), 4.7 for government priority program researchers (perceived as largely sufficient), and 4.4 for SSH researchers (perceived as not sufficient). Among experts (non-researchers), the indices are 4.6 (perceived as largely sufficient) and 5.1 (perceived as sufficient) for university management level and national institute management level, respectively. High level experts with advisory roles to STI policies has an index of 4.3 (perceived as not sufficient).

In "Q306: Securing research funding for competent mid-level and above researchers," the index for all university natural science researchers among active researchers is 3.3 (perceived as strongly insufficient). The index for natural science researchers at national research institutes is 3.4 (perceived as strongly insufficient), 3.5 for government priority programs researchers (perceived as insufficient), and 4.1 for SSH researchers (perceived as insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.6 (perceived as not sufficient) and 3.9 (perceived as not sufficient), respectively.

In "Q307: Accessibility of government public research funding," the index for all university natural science researchers is 3.7 (perceived as not sufficient) among active researchers in the front line. The index for natural science researchers at national institutes is 3.2 (perceived as strongly insufficient), 3.2 for government priority programs researchers (perceived as strongly insufficient), and 3.7 for SSH researchers (perceived as insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.5 (perceived as insufficient) and 3.8 (perceived as insufficient), respectively.

In "Q308: Content and frequency of interim- and post-evaluations of government public research funding," among active researchers, the index for all natural science researchers at universities is 5.1 (largely perceived

as sufficient). The index for natural science researchers at national research institutes is 5.0 (perceived as sufficient), 5.0 (perceived as sufficient) for government priority programs researchers, and 5.2 (perceived as sufficient) for SSH researchers. Among experts (non-researchers), the indices for university management level and national institute management level are 4.4 (perception as not sufficient) and 4.3 (perception as sufficient), respectively.

In "Q309: Diversification of perspectives for research project evaluation," the index for all university natural science researchers among active researchers is 3.9 (perceived as not sufficient). The index for natural science researchers at national research institutes is 4.1 (perceived as not sufficient), 3.9 for government priority program researchers (perceived as not sufficient), and 4.5 for SSH researchers (largely perceived as sufficient). Among experts (non-researchers), the index is 3.8 for both university management level and national institute management level (perceived as insufficient). High level experts with advisory roles to STI policies has an index of 3.3 (perceived as strongly insufficient).

Based on the above, in the sub-category of research activities and research support, the respondents tend to give relatively high scores to "Content and frequency of interim- and post-evaluations of interim- and post-evaluations of government research funding (Q308)," "Diversification of perspectives for research project evaluation (Q309)," and "Functions according to the role of the funding organization (Q305)," and relatively low scores to "Securing research funding for capable mid-level and above researchers (Q306)" and "Accessibility of government public research funding (Q307). The "availability of research funding for mid-career researchers (Q306)" and "accessibility of government public research funding (Q307)" tended to receive relatively low scores. Overall, there are no significant differences among the attributes in any of the questions. Although the small sample size does not allow for simple comparisons with other groups, SSH researchers has relatively high ratings for all questions.

The following are a summary of the issues raised in the open-ended answers in the sub-category: "Large budgets are concentrated on certain researchers, causing a bias in the distribution of research funds," "Research funds tend to be allocated to research that is currently popular, so I think the development of research that is already on track will be well supported, but support for completely new research will not be successful," "The burden of interim and post-project evaluations is too heavy. The interim evaluation should be abolished after a thorough planning at the time of project launch, and the next grant should be allocated according to the contents of the post-evaluation report."

4 Industry-academia-government collaboration and the local community

The industry-academia-government collaboration and the local community part consists of the sub-categories of "knowledge-based value creation," "intellectual property management," "regional revitalization," and "innovation talent development." Here, "innovation talent development" means "human resource development that contributes to the creation of innovation." The Basic Plan describes "promotion of new value co-creation through industry-academia-government collaboration" in the context of the formation of an innovation ecosystem. The purpose of this part is to grasp the status of efforts to apply the results of research and development to industry and society. The status of human resource development for such activities is also within the scope of this part.

4-1 Knowledge-based value creation

In the sub-category of knowledge-based value creation, the following four questions were asked to active researchers and university management level, national institute management level, and companies among experts (non-researchers). In addition, three questions (Q401, Q402, and Q404) were asked to high level experts with advisory roles to STI policies.

- ○ Q401: Do you think there are sufficient initiatives for organizational collaboration with the private sector?
- ○ Q402: Do you think that the researchers are sufficiently reflecting ideas gained through collaboration and cooperation with the private sector into their own R&D?
- ○ Q403: Do you think there is sufficient knowledge transfer and new value creation through the establishment and development of venture companies?
- ○ Q404: Do you think that human resource mobility and exchange with the private sector is sufficient (researchers moving in and out, cross-appointments, and so on)?

In either question, active researchers were asked about the status of their departments, university management level and national institute management level were asked about the status of their organizations, and high level experts with advisory roles to STI policies were asked about the general situation of Japanese universities and national research institutes.

Figure 2-11. List of questions and indices on knowledge-based value creation

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q401: Initiatives for organizational collaboration with the private sector	4.8	5.3	5.3	4.8	4.2	4.7	5.5	4.2	4.9	4.3	5.7	5.2	3.8
Q402: Reflecting ideas into R&D through collaboration with the private sector	4.6	5.1	4.8	4.4	4.1	4.6	5.2	3.8	4.7	4.0	5.1	4.8	3.8
Q403: Transferring academic knowledge to ventures	3.4	4.1	3.6	3.4	2.8	3.6	3.7	3.0	3.4	3.1	3.4	3.9	2.2
Q404: Human resource mobility and exchange with the private sector	3.2	3.9	3.5	3.1	2.6	3.4	3.5	2.8	3.3	3.0	3.5	3.1	2.9

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q401: Initiatives for organizational collaboration with the private sector	5.2	5.0	4.0	5.0	3.7	3.9
Q402: Reflecting ideas into R&D through collaboration with the private sector	4.9	4.6	3.7	4.8	3.4	-
Q403: Transferring academic knowledge to ventures	3.4	2.7	3.1	3.8	3.0	3.2
Q404: Human resource mobility and exchange with the private sector	3.0	3.3	2.6	3.1	2.5	2.5

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q401: Initiatives for organizational collaboration with the private sector," the overall index for university natural science researchers among active researchers is 4.8 (largely perceived as sufficient). By university group, there is a difference of 1.1 in the index between Group 1 and Group 2 (5.3) and Group 4 (4.2). By university department field, there is a 1.3 difference in the index between engineering/agriculture (5.5) and Health (4.2). The index for natural science researchers at national research institutes is 5.7 (perceived as sufficient), 5.2 for government priority programs researchers (largely perceived as sufficient), and 3.8 for SSH researchers (perceived as insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 5.2 (largely perceived as sufficient) and 5.0 (largely perceived as sufficient), respectively. The index for companies as a whole is 4.0 (perceived as not sufficient), for large companies (5.0) (largely perceived as sufficient), and for SMEs and university ventures (3.7) (perceived as not sufficient). High level experts with advisory roles to STI policies has an index of 3.9 (perceived as not sufficient). The index of 5.7 for natural science researchers at national institutes is 0.9 higher

than the overall index of 4.8 for university natural science researchers, and 1.7 and 1.8 higher than the overall index of 4.0 for all companies and 3.9 for high level experts with advisory roles to STI policies, respectively.

In "Q402: Reflecting ideas into R&D through collaboration with the private sector," among active researchers, the overall index for university natural science researchers is 4.6 (largely perceived as sufficient). By university group, there is a 1.0 difference in the index between Group 1 (5.1) and Group 4 (4.1). By university department field, there is a 1.4 difference in the index between engineering/agriculture (5.2) and health sciences (3.8). The index for natural science researchers at national research institutes is 5.1 (largely perceived as sufficient), 4.8 for government priority programs researchers (largely perceived as sufficient), and 3.8 for SSH researchers (perceived as not sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 4.9 (largely perceived as sufficient) and 4.6 (largely perceived as sufficient), respectively. The index for all companies is 3.7 (perceived as not sufficient), for large companies 4.8 (largely perceived as sufficient), and for SMEs and university ventures 3.4 (perceived as strongly insufficient). The index of 5.1 for natural science researchers at national institutes is 1.4 higher than the 3.7 for all companies.

In "Q403: Transferring academic knowledge to ventures and creating new value," the overall index for university natural science researchers is 3.4 (perceived as strongly insufficient) among active researchers. By university group, there is a 1.3 difference in the index between Group 1 (4.1) and Group 4 (2.8). The index for natural science researchers at national institutes is 3.4 (perceived as strongly insufficient), 3.9 for government priority programs researchers (perceived as not sufficient), and 2.2 for SSH researchers (perceived as significantly insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.4 (perceived as strongly insufficient) and 2.7 (perceived as strongly insufficient), respectively. The index for companies as a whole is 3.1 (strongly perceived as insufficient), 3.8 for large companies (strongly perceived as insufficient), and 3.0 for SMEs and university ventures (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.2 (perceived as strongly insufficient).

In "Q404: Human resource mobility and exchange with the private sector," the overall index for university natural science researchers among active researchers is 3.2 (perceived as strongly insufficient). By university group, there is a difference of 1.3 and 0.9 in the index between Group 1 (3.9), Group 2 (3.5), and Group 4 (2.6), respectively, and a difference of 0.8 between Group 1 (3.9) and Group 3 (3.1). The index for natural science researchers at national institutes is 3.5 (perceived as not sufficient), 3.1 for government priority programs researchers (perceived as strongly insufficient), and 2.9 for SSH researchers (perceived as insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.0 (perceived as strongly insufficient) and 3.3 (perceived as strongly insufficient), respectively. The index for all companies is 2.6 (perceived as strongly insufficient), 3.1 (perceived as strongly insufficient) for large companies, and 2.5 (perceived as strongly insufficient) for SMEs and university ventures. The index is 2.5 (perceived as strongly insufficient) for high level experts with advisory roles to STI policies. The index of 3.5 for natural science researchers at national institutes is 0.9 and 1.0 higher than the overall index of 2.6 and 2.5 for high level experts with advisory roles to STI policies.

Based on the above, in the sub-category of knowledge-based value creation, the indices for "Initiatives for organizational collaboration with the private sector (Q401)" and "Reflecting ideas into R&D through collaboration with the private sector (Q402)" are relatively high, while those for "Transferring academic knowledge to ventures and creating new value through the private sector (Q403)" and "Human resource flow and exchange with the private sector (Q404)" are relatively low. It is suggested that challenges are recognized in activities that involve the movement and transfer of resources and human resources between organizations. In all questions, the indices tend to be relatively high for universities with a large share of the number of papers, as well as for engineering and agriculture. In addition, the indices for SMEs and university ventures tended to be lower than those for large firms. This situation may reflect the fact that the relationship with universities and national research institutes differs depending on the size of the company. The open-ended answers on the classification include: "In order to promote knowledge-based value creation, it is important that it be recognized," and "Institutional restrictions on the establishment of venture companies and dual employment are hindering their creation." Although the small sample size does not allow for simple comparisons with other groups, SSH researchers had a relatively low index for all questions.

Other issues raised in the open-ended answers regarding the same sub-category are as follows: "In order to promote collaboration between universities and national research institutes and companies, it is necessary to bridge the gap between their respective perceptions," "Systematic support efforts are needed to promote collaboration between researchers and private companies," "Systematic restrictions on the establishment of venture companies and dual employment hinder such collaboration," "Although the cost of patent applications can be covered by external funds, the cost of maintenance must be covered by the inadequate subsidy for operating expenses, and as a result, the maintenance of patents must be given up." The opinions are mainly from within universities, national research institutes (the first point was also raised by respondents from companies). In addition, there are answers such as "My department actively collaborates with several private companies, and through these collaborations, consideration is given so that researchers can reflect the results in their own research and development," "I am involved in entrepreneurship education classes, and the number of teachers who understand such efforts is increasing year by year," and "We support the establishment of start-ups through cooperation with banks, etc."

4-2 Intellectual property management

In the sub-category of intellectual property management, the following two questions were asked to active researchers (excluding SSH researchers) and university management level, national institute management level, and companies among experts (non-researchers).

- ○ Q405: Do you think that the management of intellectual property resulting from R&D (decisions on acquisition of intellectual property rights, licensing management after acquisition of rights, and so on) is sufficiently functioning?
- ○ Q406: Do you think that funds are sufficiently secured to fill in the gap in utilizing the seeds generated by public R&D in the private sector (e.g., for prototype development, business plan formulation, and so on)?

In either question, active researchers were asked about the status of their departments, university management level and national institute management level were asked about the status of their organizations, and companies were asked about the status of their related Japanese universities and national research institutes.

Figure 2-12. List of questions and indices on IP management

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q405: Management of intellectual property resulting from R&D	4.5	4.9	4.9	4.1	4.1	4.1	4.8	4.2	4.5	4.5	5.3	4.4	-
Q406: Securing funds to utilize the seeds generated by R&D	2.9	3.6	3.2	2.6	2.5	2.9	3.0	2.8	2.9	2.8	2.9	3.0	-

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q405: Management of intellectual property resulting from R&D	4.9	4.7	3.1	3.9	2.9	-
Q406: Securing funds to utilize the seeds generated by R&D	2.8	2.1	2.1	2.6	2.0	-

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In ″ Q405: Management of intellectual property resulting from R&D,″ the overall index for university natural science researchers among active researchers in R&D is 4.5 (largely perceived as sufficient). By university group, there is a difference of 0.8 in the index between Group 1 and Group 2 (4.9) and Group 3 and Group 4 (4.1). The index for natural science researchers at national research institutes is 5.3 (largely perceived as

sufficient), while that for government priority programs researchers is 4.4 (perceived as not sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 4.9 (largely perceived as sufficient) and 4.7 (largely perceived as sufficient), respectively. The index for all companies is 3.1 (perceived as strongly insufficient), for large companies 3.9 (perceived as not sufficient), and for SMEs and university ventures 2.9 (perceived as strongly insufficient). The index of 5.3 for natural science researchers at national institutes and 4.5 for university natural science researchers as a whole are 2.2 and 1.4 higher, respectively, than the index of 3.1 for all companies.

In "Q406: Securing funds to utilize the seeds generated by R&D," among active researchers, the overall index for university natural science researchers is 2.9 (perceived as strongly insufficient). By university group, Group 1 (3.6) and Group 3 (2.6) and Group 4 (2.5), the indices differ by 1.0 and 1.1, respectively. The index for natural science researchers at national institutes is 2.9 (perceived as strongly insufficient), while that for government priority programs researchers is 3.0 (perceived as strongly insufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 2.8 (perceived as strongly insufficient) and 2.1 (perceived as significantly insufficient), respectively. The index for all companies is 2.1 (perceived as significantly insufficient), 2.6 (perceived as strongly insufficient) for large companies, and 2.0 (perceived as significantly insufficient) for SMEs and university ventures. There is a 0.8 difference between the index of 2.9 for natural science researchers at national research institutes and 2.1 for national institute management level. There is also a difference of 0.8 between the index of 2.9 for all natural science researchers at universities and natural science researchers at national institutes and 2.1 for all companies.

Based on the above, in the sub-category of intellectual property management, "Management of intellectual property resulting from R&D (Q405)" tends to be relatively highly rated, while "Securing funds to utilize the seeds generated by R&D (Q406)" is relatively poorly rated. In addition, for all of the questions, the evaluation by companies tends to be lower than that by active researchers.

The following are some of the points raised in the open-ended answers in the sub-category: "Although progress is being made in IPR of research results, the costs of application and maintenance of rights are not sufficient," and "Although university IP departments are enthusiastic about protecting IP rights, they are not necessarily enthusiastic about collaboration with companies that utilize IP." Both opinions on these issues are found in both the respondents from universities and national research institutes and those from companies.

4-3 Regional revitalization

In the regional revitalization sub-category, all respondents in the group of active researchers and experts (non-researchers) were asked the following two questions.

- ○ Q407: Do you think there are sufficient efforts for development of human resources that contribute to regional revitalization?
- ○ Q408: Do you think there are enough efforts for research and innovation that contributes to regional revitalization?

In either question, active researchers were asked about the status of their departments, university management level and national institute management level were asked about the status of their organizations, and companies were asked about the status of their related Japanese universities and national research institutes.

Figure 2-13. List of questions and indices on regional revitalization

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q407: Development of human resources that contribute to regional revitalization	4.7	4.0	4.8	5.0	4.8	4.6	5.3	4.1	4.8	4.5	3.5	4.5	5.4
Q408: Research and innovation that contributes to regional revitalization	4.7	4.1	4.9	4.9	4.6	4.5	5.3	4.0	4.7	4.4	4.1	4.3	5.2

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q407: Development of human resources that contribute to regional revitalization	5.6	4.4	3.6	4.1	3.5	3.2
Q408: Research and innovation that contributes to regional revitalization	5.7	4.9	3.7	4.1	3.6	3.4

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q407: Development of human resources that contribute to regional revitalization," the overall index for university natural science researchers among active researchers is 4.7 (largely perceived as sufficient). By university group, Group 2 (4.8), Group 3 (5.0), and Group 4 (4.8) and Group 1 (4.0), there is a difference of about 1 point in the index. By university department field, there is a difference of 1.2 in the index between engineering and agriculture (5.3) and health (4.1). The index for natural science researchers at national research institutes is 3.5 (perceived as not sufficient), 4.5 for government priority programs researchers (largely perceived as sufficient), and 5.4 for SSH researchers (largely perceived as sufficient). Among experts (non-

researchers), the indices for university management level and national institute management level are 5.6 (perceived as sufficient) and 4.4 (perceived as not sufficient), respectively. The index for companies as a whole is 3.6 (perceived as not sufficient), for large companies 4.1 (perceived as not sufficient), and for SMEs and university ventures 3.5 (perceived as not sufficient). For high level experts with advisory roles to STI policies, the index is 3.2 (perceived as strongly insufficient). There is a difference of 0.9 between the index of 5.6 for university management level and 4.7 for all natural science researchers at national institutes management level, and a difference of 0.9 between the index of 4.4 for national institute management level and 3.5 for natural science researchers at national institutes. There is a difference of 1.1 and 1.5 in the index between 4.7 for all natural science researchers at universities and 3.6 for all firms and 3.2 for high level experts with advisory roles to STI policies, respectively.

In ″Q408: Research and innovation that contributes to regional revitalization,″ the overall index for university natural science researchers among active researchers is 4.7 (largely perceived as sufficient). By university group, there is a difference of 0.8 in the index between Group 2 (4.9) and Group 3 (4.9) and Group 1 (4.1). By university department field, there is a difference of 1.3 in the index between engineering/agriculture (5.3) and health (4.0). The index for natural science researchers at national research institutes is 4.1 (perceived as not sufficient), 4.3 for government priority program researchers (perceived as not sufficient), and 5.2 for SSH researchers (largely perceived as sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 5.7 (perceived as sufficient) and 4.9 (largely perceived as sufficient). The index for companies as a whole is 3.7 (perceived as not sufficient), 4.1 (perceived as not sufficient) for large companies, and 3.6 (perceived as not sufficient) for SMEs and university ventures. For high level experts with advisory roles to STI policies, the index is 3.4 (perceived as strongly insufficient). There is a difference of 1.0 between the index of 4.7 for all natural science researchers at universities and 5.7 for the university management level, and a difference of 0.8 between the index of 4.1 for natural science researchers at national institutes and 4.9 for the national institute management level, with the management level having a higher rating in both cases. While the index is 3.4 for high level experts with advisory roles to STI policies compared to 4.7 for university natural science researchers as a whole, a difference of 1.3.

Based on the above, in the sub-category of regional revitalization, for all questions, the indices tend to be higher in Group 2 to Group 4, which include many universities outside of metropolitan areas. In addition, the indices tend to be higher for engineering and agriculture, indicating the characteristics of each field. In addition, the index tends to be higher for management than for researchers in the field. While the indices for companies and high level experts with advisory roles to STI policies tended to be low. This suggests that, although universities and national research institutes are recognized to be making systematic efforts, they are not recognized as such by those outside the organizations. The following are a summary of the issues raised in the open-ended answers regarding the sub-category: ″The situation should be corrected where researchers and organizations working on regional revitalization are not evaluated,″ ″Regional revitalization requires a long-term perspective, but there is no mechanism to evaluate it from that perspective,″ and ″For universities in Tokyo, support related to regional revitalization is often remote. However, if a university can contribute to regional revitalization even if its base of operations is not located in the region, it should be eligible for support.″ The first two issues are related to both internal and external opinions of the universities and national research

institutes, while the last issue is related to the internal opinions of the respondents. The index by SSH researchers also tend to be high, although it cannot be simply compared with other groups due to the small sample size. The open-ended answers by SSH researchers include "We are contributing to the community and government through educational activities, compilation of municipal histories, etc."

Other points of discussion in the open-ended answers regarding the same sub-category includes the following: "It is necessary to systematically secure resources to engage in regional revitalization." In addition, there are some good examples, such as "The University provides living expense subsidies to students in order to develop human resources that contribute to regional revitalization," and "Our university has as one of its missions the promotion of social contribution and industry-university collaboration in response to regional issues, and has generated a lot of intellectual property through collaboration with regional organizations and private companies."

4-4 Innovation talent development

In the innovation talent development sub-category, all respondents in the group of active researchers and experts (non-researchers) were asked the following two questions.

- ○ Q409: Do you think there are sufficient efforts for fostering R&D personnel (researchers and engineers) in response to changes in society and industry?
- ○ Q410: Do you think there are sufficient efforts to develop human resources with an entrepreneurship?

In either question, active researchers were asked about the status of their departments, university management level and national institute management level were asked about the status of their organizations, and companies were asked about the status of their related Japanese universities and national research institutes.

Figure 2-14. List of questions and indices on innovation talent development

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q409: Fostering R&D personnel in response to changes in society and industry	4.5	5.4	5.0	4.3	3.8	5.2	5.3	3.5	4.6	4.0	4.4	4.3	4.8
Q410: Develop human resources with an entrepreneurial spirit	3.6	4.3	3.9	3.4	3.0	3.9	4.0	3.0	3.7	3.0	3.7	3.6	4.1

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q409: Fostering R&D personnel in response to changes in society and industry	5.2	5.3	3.3	4.2	3.1	3.3
Q410: Develop human resources with an entrepreneurial spirit	4.4	3.8	2.8	3.3	2.6	2.7

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q409: Fostering R&D personnel in response to changes in society and industry," among active researchers, the overall index for natural science researchers at universities is 4.5 (largely perceived as sufficient). By university group, Group 1 (5.4) and Group 3 (4.3) and Group 4 (3.8), the indices differed by 1.1 and 1.6, respectively. By university department field, there is a difference of 1.8 and 1.7 in the index between engineering/agriculture (5.3), science (5.2) and health (3.5), respectively. The index for natural science researchers at national research institutes is 4.4 (perceived as not sufficient), 4.3 for government priority program researchers (perceived as not sufficient), and 4.8 for SSH researchers (largely perceived as sufficient). Among experts (non-researchers), the indices for university management level and national institute

management level are 5.2 (largely perceived as sufficient) and 5.3 (perceived as sufficient), respectively. The index for companies as a whole is 3.3 (perceived as strongly insufficient), for large companies 4.2 (perceived as not sufficient), and for SMEs and university ventures 3.1 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.3 (perceived as strongly insufficient). There is a difference of 0.9 between the index of 4.4 for natural science researchers at national research institutes and 5.3 for national institute management level. There is also a difference of 1.2 between the index of 4.5 for university natural science researchers as a whole and 3.3 for all the companies and high level experts with advisory roles to STI policies.

In "Q410: Develop human resources with an entrepreneurial spirit, etc.," the overall index for university natural science researchers among active researchers is 3.6 (perceived as not sufficient). By university group, Group 1 (4.3), Group 2 (3.9), and Group 4 (3.0), the indices differ by 1.3 and 0.9, respectively. By university department field, there is a difference of 1.0 and 0.9 in the index between engineering/agriculture (4.0), science (3.9) and health (3.0), respectively. The index for natural science researchers at national institutes is 3.7 (perceived as not sufficient), 3.6 for government priority programs researchers (perceived as not sufficient), and 4.1 for SSH researchers (perceived as not sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 4.4 (perceived as not sufficient) and 3.8 (perceived as not sufficient), respectively. The index for all companies is 2.8 (perceived as strongly insufficient), for large companies 3.3 (perceived as strongly insufficient), and for SMEs and university ventures 2.6 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 2.7 (perceived as strongly insufficient). The index for the university management level is 4.4, compared to 3.6 for all university natural science researchers, a difference of 0.8. There is a difference of 0.8 and 0.9 between the index of 3.6 for university natural science researchers as a whole and 2.8 for companies as a whole and 2.7 for high level experts with advisory roles to STI policies, respectively.

Based on the above, in the sub-category of innovation talent development, the indices for "Fostering R&D personnel in response to changes in society and industry (Q409)" tend to be lower than that for "Developing human resources with an entrepreneurial spirit (Q410)," indicating an awareness of the issues in the latter category. By university group, the indices for universities with a large share of papers tend to be higher than that for universities with a small share of papers. By field, the indices in science and engineering/agriculture tended to be higher than that in health. In addition, the indices tend to be higher for management than for researchers in the field. However, the indices for companies and high level experts with advisory roles to STI policies, who are in a position to look at universities, national research institutes, etc. from the outside, tend to be lower.

The following are some of the points raised in the open-ended answers regarding the classification: "I feel that university education focuses on career building and is far from a system to educate personnel who can build new industries through innovation," and "There are many people around me who are forced to engage in short-sighted research due to the need for short-term results and do not think about fostering innovative research personnel."

5 University functional expansion and strategic management

The part of "University functional expansion and strategic management" consists of the sub-categories of "University functional expansion and strategic management" and "University functional expansion." In the Basic Plan, as "promotion of university reform and functional expansion for strategic management," specific initiatives include the transformation of national university corporations into true management entities, deregulation to support strategic management, and the creation of a 10 trillion-yen university fund. In light of this, this part asks questions regarding the status of "university management" and "university functional expansion." In the former, questions were asked mainly about the status of university activities aimed at self-reform and securing diverse financial resources, while in the latter, questions were asked about universities from the perspective of society and deregulation to support university management.

5-1 University management

In the sub-category of university management, the following three questions were asked to active researchers (excluding those affiliated with national institutes) and university management level among experts (non-researchers). In addition, two questions, Q502 and Q503, were asked to companies and high level experts with advisory roles to STI policies.

- ○ Q501: Do you think the institution has sufficient ability to collect and analyze information on its education / research and management?
- ○ Q502: Do you think that efforts to promote self-improvement by making the most of the organization's individuality and characteristics (review of internal organization, appropriate allocation of research funds, branding of the university, and so on) are sufficiently implemented?
- ○ Q503: Do you think that efforts to secure various financial resources (e.g., joint research funds from companies, endowments, ESG investments/impact investments, and so on) are sufficiently implemented?

In all questions, active researchers (excluding those affiliated with national research institutes) and university management level among experts (non-researchers) were asked about the status of their organizations, while companies were asked about the status of their related Japanese universities, and high level experts with advisory roles were asked about the general status of Japanese universities.

Figure 2-15. List of questions and indices on university management

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q501: Ability to collect and analyze info. on the org.'s education/research and management	5.4	6.9	5.6	4.9	4.7	6.1	5.4	5.2	5.4	5.4	-	5.2	5.8
Q502: Efforts for self-improvement, making the most of the org.'s individuality and characteristics	5.5	6.2	5.9	5.1	5.1	5.7	5.6	5.4	5.6	5.2	-	5.3	5.9
Q503: Efforts to secure various financial resources	5.0	6.4	5.3	4.7	4.0	5.3	5.1	4.8	5.0	5.1	-	5.1	5.6

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q501: Ability to collect and analyze info. on the org.'s education/research and management	5.4	-	-	-	-	-
Q502: Efforts for self-improvement, making the most of the org.'s individuality and characteristics	5.5	-	3.7	4.4	3.5	3.9
Q503: Efforts to secure various financial resources	4.8	-	3.6	4.1	3.4	3.5

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q501: Ability to collect and analyze information on the organization's education/research and management," among active researchers, the overall index for natural science researchers at universities is 5.4 (largely perceived as sufficient). By university group, Group 1 have the highest index at 6.9, followed by Group 2 at 5.6. There is a difference of about 2 points in the index between Group 1, Group 3 (4.9), and Group 4 (4.7). The index for government priority programs researchers is 5.2 (largely perceived as sufficient), and for SSH researchers, 5.8 (perceived as sufficient). Among experts (non-researchers), the index for university management level is 5.4 (largely perceived as sufficient). The index for both university natural science researchers as a whole and the university management level is 5.4, showing no difference in perception between the two groups.

In "Q502: Efforts to promote self-improvement by making the most of the organization's individuality and characteristics," the overall index for university natural science researchers among active researchers is 5.5 (perceived as sufficient). By university group, Group 1 (6.2) and Group 2 (5.9), and Group 3 (5.1) and Group 4 (5.1), there are differences of about 1 point in the indices. The index for government priority programs researchers is 5.3 (largely perceived as sufficient), and for SSH researchers, 5.9 (perceived as sufficient). Among experts (non-researchers), the index for university management level is 5.5 (perceived as sufficient). The index for companies as a whole is 3.7 (perceived as not sufficient), for large companies 4.4 (perceived as not sufficient),

and for SMEs and university ventures 3.5 (perceived as not sufficient). High level experts with advisory roles to STI policies have an index of 3.9 (perceived as not sufficient). The indices for university natural science researchers as a whole and university management level are both 5.5, and there is no difference in perception between them. Compared to the university management level, the index for the entire enterprise and high level experts with advisory roles to STI policies is 1.8 for the former and 1.6 lower for the latter.

In "Q503: Efforts to secure various financial resources," among active researchers, the index for university natural science researchers as a whole is 5.0 (largely perceived as sufficient). By university group, Group 1 has the highest index at 6.4, followed by Group 2 at 5.3. There is a difference of about 2 points in the index between Group 1, Group 3 (4.7), and Group 4 (4.0). The index for government priority programs researchers is 5.1 (largely perceived as sufficient), while that for SSH researchers is 5.6 (perceived as sufficient). Among experts (non-researchers), the index for university management level is 4.8 (largely perceived as sufficient). The index for companies as a whole is 3.6 (perceived as insufficient), for large companies 4.1 (perceived as not sufficient), and for SMEs and university ventures 3.4 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.5 (perceived as not sufficient). The indices for university natural science researchers overall and university management level are 5.0 and 4.8, respectively, with no difference in perception between the two groups. Compared to the university management level, the indices for the entire enterprise and high level experts with advisory roles to STI policies are 1.2 and 1.3 lower for the former and latter, respectively.

Based on the above, the sub-category of university management show marked differences in recognition by university group in each of the following areas: "Ability to collect and analyze information on the organization's education/research and management (Q501)," "Efforts to promote self-improvement by making the most of the organization's individuality and characteristics (Q502)," and "Efforts to secure various financial resources (Q503). In particular, Group 1 generally shows the perceptions as sufficient, which can be considered a result of the different degree of progress in various efforts related to university management depending on the university group. In summarizing the issues raised in the open-ended answers in the sub-category, there are opinions that "Smaller universities that are struggling to secure financial and human resources should be strengthened and the diversity of universities should be ensured," and that "Part of the executive board of university management should be composed of specialists in various fields, including people invited from outside the university." In addition, it becomes clear that there is a large difference in perception between university management level and companies or high level experts with advisory roles to STI policies in "Efforts to promote self-improvement by making the most of the organization's individuality and characteristics (Q502)" and "Efforts to secure various financial resources (Q503)". Compared to the university management level, companies and the high level experts tend to show perceptions of strongly insufficient. This may be because various efforts to improve university management are not clearly visible from outside the university, or that there is more room for improvement in various efforts related to university management than in the management of companies and other organizations.

Other points in the open-ended answers regarding the sub-category include: "There are significant constraints from the single-year budget system and the systems such as investment and university bonds under the Public University Corporation Law," "It is difficult to see what is being achieved through reform from the

perspective of researchers in the field," and "As a result of strategic management and reform becoming self-objectives, the burden on researchers is increasing as they have to spend more time wasteful work, resulting in reduction of time for research." In addition, there are comments from inside the university such as, "Taking advantage of being a university with broad range of faculties, we have a good research support system to conduct cross-faculty joint research," "We are making efforts to secure financial resources by conducting joint research with local companies," "Recently, we have actively recruited female PIs and foreign PIs, strengthened financial support for graduate students, improved the environment for shared-use equipment, and reformed the organization."

5-2 University functional expansion

In the sub-category of university functional expansion, the following two questions were asked to university management level and high level experts with advisory roles to STI policies among experts (non-researchers). In addition, companies were asked in Q504.

- ○ Q504: Do you think universities are sufficiently engaged in initiatives aimed at driving new social change through dialogue and co-creation with diverse stakeholders?
- ○ Q505: Do you think systems for flexible university management* is sufficiently implemented?
  Changes in student admission capacity at national universities, more flexible tuition setting, simplified procedures for organizational restructuring, and so on.

In either question, the university management level was asked about the general situation in Japan, companies were asked about the situation of Japanese universities related to their own, and the high level experts with advisory roles to STI policies were asked about the general situation in Japan.

Figure 2-16. List of questions and indices for university functional expansion

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q504: Initiatives for social change through co-creation with diverse parties	4.4	–	3.3	4.0	3.1	3.5
Q505: Improving systems for flexible university management	3.3	–	–	–	–	2.4

Note: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q504: Initiatives for social change through co-creation with diverse parties," among experts (non-researchers), the index is 4.4 (perceived as not sufficient) for the university management level. The index for companies as a whole is 3.3 (perceived as strongly insufficient), for large companies 4.0 (perceived as not sufficient), and for SMEs and university ventures 3.1 (perceived as strongly insufficient). High level experts with advisory roles to STI policies had an index of 3.5 (perceived as not sufficient). Compared to the university management level, the indices for the company as a whole and high level experts with advisory roles to STI policies are about 1 point lower.

In "Q505: Improving systems for flexible university management," among experts (non-researchers), the index is 3.3 (perceived as strongly insufficient) for the university management level. High level experts with advisory roles to STI policies has an index of 2.4 (perceived as significantly insufficient). Compared to the university management level, the index for high level experts with advisory roles to STI policies is 0.9 lower.

Based on the above, the sub-categories of university functional expansion revealed that there is a difference in perception between university management level and companies and high level experts with advisory roles to STI policies regarding "Initiatives for social change through co-creation with diverse parties (Q504)" and

"Improving systems for flexible university management (Q505)". Companies and high level experts with advisory roles to STI policies recognize the need for universities to make further initiatives for social change through co-creation with diverse parties. In summarizing the issues raised in the open-ended answers by companies and high level experts with advisory roles to STI policies, there is an opinion such as "In order for universities to become a driving force for new social changes, a system to evaluate and promote faculty members who are involved in social implementation based on values other than academic papers is necessary." In addition to university management level, high level experts with advisory roles to STI policies also perceive as strongly insufficient in terms of improving systems for flexible university management. The open-ended answers regarding the same sub-category contain opinions that "University functional expansion requires giving universities more freedom in management."

6 Science, Technology, Innovation and Society

The science, technology, innovation and society part consists of sub-categories of "Relationship with Society," "Utilization of 'Comprehensive Knowledge'," "Construction of Innovation System," "Promotion of Open Innovation," "International Collaboration" and "Research Integrity." The Basic Plan states the need to promote R&D and social implementation to solve various social issues, to utilize comprehensive knowledge, and to form an innovation ecosystem that will serve as a foundation for creating new value-creating industries, in order to realize "transformation into a sustainable and resilient society that ensures the safety and security of its citizens".

Of the sub-categories in the part, "Relationship with Society" and "Utilization of 'Comprehensive Knowledge'" are questions related to the former, and are intended to qualitatively understand the progress of the "comprehensive knowledge" presented in the Basic Plan. The questions on "Establishment of an innovation system" and "Promotion of open innovation" are related to the latter, and focus on innovation policies such as introduction or relaxation of regulations, establishment of venues for demonstration experiments, financial and fiscal support, and systems such as those promoting standardization. In addition, since internationalization is an important perspective in conducting research activities and concerns about outflow of scientific and technological information, etc. have been increasing in recent years, questions on the status of "international collaboration" and "research integrity" are also asked in this part.

6-1 Relationship with society

In the sub-category of relationship with society, all respondents in the group of active researchers and experts (non-researchers) were asked the following three questions.

- ○ Q601: Do you think the research community (e.g., academic societies) is sufficiently engaged in activities to promote public understanding of science, technology and innovation?
- ○ Q602: Do you think the research community (e.g., academic societies) is sufficiently engaged in co-creating research activities with diverse entities such as local governments, NPO/NGOs, and citizens?
- ○ Q603: Do you think researchers engage in research while sufficiently considering the relationship between their research and social issues (declining birthrate, aging population, climate change, infectious diseases, etc.) and the social significance/value of their research?

In either questions, active researchers were asked about the general situation in Japan in their own research field, and experts (non-researchers) were asked about the general situation in Japan.

Figure 2-17. List of questions and indices on social relations

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q601: Activities to promote public understanding for science, technology, and innovation	5.9	6.0	5.8	6.0	5.7	5.8	5.9	5.8	5.9	5.7	5.6	5.5	5.0
Q602: Research activities co-created with diverse entities	4.9	4.7	4.8	5.0	5.1	4.7	4.9	5.0	4.9	5.0	4.6	4.5	4.8
Q603: Research activities that take into account social significance and value	5.9	5.6	5.7	6.0	6.0	5.3	6.0	5.9	5.8	6.3	6.2	5.4	5.8

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q601: Activities to promote public understanding for science, technology, and innovation	4.4	4.4	3.3	3.8	3.2	4.1
Q602: Research activities co-created with diverse entities	4.0	4.0	3.3	3.8	3.2	3.1
Q603: Research activities that take into account social significance and value	5.0	4.9	4.2	4.9	4.0	4.4

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q601: Activities to promote public understanding for science, technology, and innovation by the research community (academic societies, etc.)," the overall index for university natural science researchers among active researchers is 5.9 (perceived as sufficient). The index for natural science researchers at national research institutes is 5.6 (perceived as sufficient), that for government priority programs researchers is 5.5 (perceived as sufficient), and that for SSH researchers is 5.0 (largely perceived as sufficient). Among experts (non-researchers), the index for both university management level and national institute management level is 4.4 (perceived as not sufficient). The index for all companies is 3.3 (perceived as strongly insufficient), for large companies 3.8 (perceived as insufficient), and for SMEs and university ventures 3.2 (strongly perceived as insufficient). For high level experts with advisory roles to STI policies, the index is 4.1 (perceived as not sufficient). Compared to natural science researchers at universities, the indices for university management level, national institute management level, companies as a whole, and high level experts with advisory roles to STI policies are about 2 to 3 points lower.

In "Q602: Research activities co-created with diverse entities by research communities (academic societies, etc.)," the index for university natural science researchers among active researchers is 4.9 (largely perceived as sufficient). The index for natural science researchers at national research institutes is 4.6 (perceived as sufficient), that for government priority programs researchers is 4.5 (largely perceived as sufficient), and that

for SSH researchers is 4.8 (largely perceived as sufficient). Among experts (non-researchers), the indices for both university management level and national institute management level are 4.0 (perceived as not sufficient). The index for all companies is 3.3 (strongly perceived as insufficient), for large companies 3.8 (perceived as not sufficient), and for SMEs and university ventures 3.2 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.1 (perceived as strongly insufficient). Compared to natural science researchers at universities, the indices for university management level, national institute management level, companies as a whole, and high level experts with advisory roles to STI policies are about 1 to 2 points lower.

In "Q603: Research activities that take into account social significance and value", the overall index for university natural science researchers among active researchers is 5.9 (perceived as sufficient). The index for natural science researchers at national research institutes is 6.2 (perceived as sufficient), that for government priority programs researchers is 5.4 (largely perceived as sufficient), and that for SSH researchers is 5.8 (perceived as sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 5.0 (largely perceived as sufficient) and 4.9 (largely perceived as sufficient), respectively. The index for companies as a whole is 4.2 (perceived as not sufficient), for large companies (4.9) (largely perceived as sufficient), and for SMEs and university ventures (4.0) (perceived as not sufficient). High level experts with advisory roles to STI policies had an index of 4.4 (perceived as not sufficient). Compared to university natural science researchers as a whole, the indices for university management level, the company as a whole, and high level experts with advisory roles to STI policies are about 1 to 2 points lower.

Based on the above, it becomes clear that there is a gap in perception between researchers and others in the sub-category of relationship with society. Specifically, "Activities to promote public understanding for science, technology, and innovation by the research community (academic societies, etc.)" (Q601), "Research activities co-created with diverse entities by the research community (academic societies, etc.)" (Q602), and "Research activities that take into account social significance and value by researchers" (Q603). In either case, active researchers perceive as sufficient or largely sufficient, while management level at universities, national institute management level, companies as a whole, and high level experts with advisory roles to STI policies perceive as largely insufficient. Comparing Q601 and Q602 for researchers, the former tends to have higher indices than the latter, indicating that compared to activities to promote public understanding for science, technology, and innovation, research activities co-created with diverse entities are perceived to have much room for improvement as a research community (academic societies, etc.).

The open-ended answers in the same sub-category include: "Contribution to society and outreach activities must be undertaken on a voluntary basis and with limited budgets, and are not always appreciated," and "Community and international activities are most adversely affected by the Covid-19 pandemic."

6-2 Utilization of "comprehensive knowledge"

In the sub-category of the use of "comprehensive knowledge"[1], the following two questions were asked to all respondents in the group of active researchers and experts (non-researchers).

- ○ Q604: Do you think that efforts are sufficiently made for collaboration among different fields (including collaboration between the social sciences and humanities and natural sciences) in setting research questions based on social issues?
- ○ Q605: Do you think that efforts are sufficiently made for collaboration among different fields (including collaboration between the social sciences and humanities and natural sciences) in conducting R&D aimed at solving social issues?

In both questions, active researchers were asked about the general situation in Japan in their own research field, and experts (non-researchers) were asked about the general situation in Japan.

Figure 2-18. List of questions and indices on the ulitilization of "comprehensive knowledge"

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q604: Collaboration among different disciplines on setting up research projects based on social issues	4.4	4.6	4.6	4.1	4.4	4.7	4.8	3.9	4.4	4.5	4.9	4.5	5.2
Q605: Collaboration among different disciplines on conducting R&D based on social issues	4.3	4.5	4.1	4.1	4.4	4.3	4.5	3.9	4.2	4.4	4.7	4.4	4.8

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q604: Collaboration among different disciplines on setting up research projects based on social issues	3.5	3.8	2.8	3.3	2.6	3.1
Q605: Collaboration among different disciplines on conducting R&D based on social issues	3.4	3.7	2.9	3.4	2.7	2.9

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q604: Collaboration among different disciplines (when setting up research projects based on social issues)," the index for all university natural science researchers among active researchers is 4.4 (perceived as not sufficient). By university department field, there is a difference of 0.9 and 0.8 in the index between engineering and agriculture (4.8), science (4.7) and health (3.9), respectively. The index for natural science researchers at national institutes is 4.9 (largely perceived as sufficient), that for government priority programs

[1] Here, we ask about the use of "integrated knowledge" from the aspect of collaboration among different disciplines.

researchers is 4.5 (largely perceived as sufficient), and that for SSH researchers is 5.2 (largely perceived as sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.5 (perceived as not sufficient) and 3.8 (perceived as not sufficient). The index for all companies is 2.8 (perceived as strongly insufficient), for large companies 3.3 (perceived as strongly insufficient), and for SMEs and university ventures 2.6 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.1 (perceived as strongly insufficient). Compared to natural science researchers at universities and at national institutes, the indices for university and national institute management level, companies as a whole, and high level experts with advisory roles to STI policies are about 1 to 2 points lower.

In "Q605: Collaboration among different disciplines (when conducting R&D based on social issues)," among active researchers, the index for all natural science researchers at universities is 4.3 (perceived as not sufficient). The index for natural science researchers at national research institutes is 4.7 (largely perceived as sufficient), that for government priority programs researchers is 4.4 (perceived as not sufficient), and that for SSH researchers is 4.8 (largely perceived as sufficient). Among experts (non-researchers), the indices for university management level and national institute management level are 3.4 (perceived as strongly insufficient) and 3.7 (perceived as insufficient), respectively. The index for all companies is 2.9 (perceived as strongly insufficient), 3.4 (perceived as strongly insufficient) for large companies, and 2.7 (perceived as strongly insufficient) for SMEs and university ventures. For high level experts with advisory roles to STI policies, the index is 2.9 (perceived as strongly insufficient). Compared to natural science researchers at universities and at national institutes to STI policies, the indices for university and national institute management level, companies as a whole, and high level experts with advisory roles to STI policies are about 1 to 2 points lower.

Based on the above, in the sub-category of "utilization of comprehensive knowledge," a gap is found between active researchers and others in terms of recognition in both "collaboration among different fields (when setting a research agenda based on social issues) (Q604)" and "collaboration among different fields (when implementing a research agenda based on social issues) (Q605)" questions. In addition, it becomes clear that there are differences in the perception in the former question depending on the field of the university department. Specifically, compared to researchers, management level at universities and national research institutes, companies as a whole, and high level experts with advisory roles to STI policies perceive as insufficient relatively more strongly. Regarding university departmental fields, differences are also found between engineering/agriculture and health. Summarizing the open-ended answers regarding the sub-category, "Japanese tradition of separating social sciences and humanities and natural sciences needs to be abolished in order to promote collaboration among different fields," "In order to encourage the use of "integrated knowledge," it is necessary to evaluate it." There are also answers on that portfolios should be considered, such as "Not all themes and people are suited for the promotion of "comprehensive knowledge", and "One researcher cannot conduct all basic research, "comprehensive knowledge," and open innovation." Other opinions include: "Further interaction among researchers is necessary to promote "comprehensive knowledge"," and "We should not neglect the knowledge that forms the basis of "comprehensive knowledge" by only emphasizing its social significance."

6-3 Building an innovation system

In the sub-category of building an innovation system, the following four questions were asked to companies and high level experts with advisory roles to STI policies among experts (non-researchers). In addition, two questions, Q607 and Q608, were asked to university management level and national institute management level.

- ○ Q606: Do you think that enhancement of systems to promote innovation (including introduction or relaxation of regulations) is sufficiently implemented?
- ○ Q607: Do you think that support for the establishment and management of science and technology-based ventures is sufficient (e.g., securing risk money, creating an environment that allows for challenge and failure, providing information and know-how, and so on)?
- ○ Q608: Do you think that the number of sites where cutting-edge technologies can be demonstrated (e.g., super cities, smart cities, and so on) are sufficiently expanded?
- ○ Q609: Do you think the government sufficiently promotes R&D investment by companies through financial and fiscal support (government procurement, subsidies, tax incentives, and so on)?

Either question asked about the general situation in Japan.

Figure 2-19. List of questions and indices on building an innovation system

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q606: Enhancement of systems to promote innovation	–	–	2.8	3.2	2.7	2.9
Q607: Support for the establishment and management of science / technology based ventures	2.8	2.4	1.9	2.6	1.8	2.5
Q608: Expanding the number of sites where cutting-edge technologies can be demonstrated	2.6	2.3	2.3	2.8	2.2	2.7
Q609: Promote corporate R&D investment through financial and fiscal support	–	–	2.3	2.8	2.2	2.5

Note: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q606: Enhancement of systems to promote innovation," the index for all companies is 2.8 (perceived as strongly insufficient), for large companies it is 3.2 (perceived as strongly insufficient), and for SMEs and university ventures it is 2.7 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 2.9 (perceived as strongly insufficient).

In "Q607: Support for the establishment and management of science and technology-based ventures," the indices are 2.8 (perceived as strongly insufficient) and 2.4 (perceived as significantly insufficient) for the university management level and national institute management level. The index for all companies is 1.9 (perceived as significantly insufficient), 2.6 (perceived as strongly insufficient) for large companies, and 1.8

(perceived as significantly insufficient) for SMEs and university ventures. Compared to large companies, the index for SMEs and university ventures is 0.8 lower. High level experts with advisory roles to STI policies has an index of 2.5 (perceived as strongly insufficient).

For "Q608: Expanding the sites where cutting-edge technologies can be demonstrated," the index is 2.6 (perceived as strongly insufficient) and 2.3 (perceived as significantly insufficient) for university management level and national institute management level, respectively. The index for all companies is 2.3 (perceived as significantly insufficient), for large companies 2.8 (perceived as strongly insufficient), and for SMEs and university ventures 2.2 (perceived as significantly insufficient). For high level experts with advisory roles to STI policies, the index is 2.7 (perceived as strongly insufficient).

In "Q609: Promote corporate R&D investment through financial and fiscal support," the index is 2.3 (perceived as significantly insufficient) for all companies, 2.8 (perceived as strongly insufficient) for large companies, and 2.2 (perceived as significantly insufficient) for SMEs and university ventures. For high level experts with advisory roles to STI policies, the index is 2.5 (perceived as strongly insufficient).

Based on the above, the sub-categories of "Enhancement of systems to promote innovation (Q606)," "Support for the establishment and management of science and technology-based ventures (Q607)," "Expanding the number of sites where cutting-edge technologies can be demonstrated (Q608)," and "Financial and fiscal support for venture start-ups and management (Q607)," "expansion of opportunities to conduct demonstration tests of cutting-edge technologies (Q608)," and "promotion of corporate R&D investment through financial and fiscal support (Q609)" are all perceived as strongly insufficient or perceived as significantly insufficient. Generally, insufficiency is more strongly perceived among SMEs and university ventures compared to large companies, although the difference in indices exceeds 0.8 for only one question, which is set as the guideline for discussing the index difference in the report. In light of these results, it is considered necessary to establish an innovation system that is accessible not only to large companies, but also to SMEs and university ventures. The following are some of the points raised in the open-ended answers in the sub-category: "The regulatory barriers to launching new products in Japan are higher than in other countries," "In supporting ventures, it is important to consider the inflow of appropriate human resources and the utilization of technologies and business ideas from local universities," and "Measures such as deregulation tend to be introduced in a way that favors large companies."

6-4 Promoting open innovation

In the sub-category of promoting open innovation, the following two questions were asked to university management level, national institute management level, companies, and high level experts with advisory roles to STI policies among experts (non-researchers).

- ○ Q610: Are industry-academia-government efforts to develop open innovation hubs sufficiently implemented?
- ○ Q611: Do you think there are sufficient efforts to develop system to promote industry-academia-government collaboration on standardization based on the results of R&D (forum standards, de facto standards, de jure standards, and so on)?

Both questions asked about the general situation in Japan.

Figure 2-20. List of questions and indices on promoting open innovation

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q610: Industry-academia-government efforts to develop open innovation sites	3.4	3.5	3.2	3.8	3.1	3.2
Q611: Establishment of a standardization promotion system through industry-academia-government collaboration	3.0	2.8	2.8	3.2	2.7	2.5

Note: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q610: Industry-academia-government efforts to develop open innovation sites," among experts (non-researchers), the index is 3.4 (perceived as strongly insufficient) and 3.5 (perceived as not sufficient) for the university management level and the national institute management level. The index for all companies is 3.2 (perceived as strongly insufficient), 3.8 for large companies (perceived as strongly insufficient), and 3.1 for SMEs and university ventures (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.2 (perceived as strongly insufficient).

In "Q611: Establishment of a standardization promotion system through industry-academia-government collaboration," the index is 3.0 (perceived as strongly insufficient) and 2.8 (perceived as strongly insufficient) for university management level and national institute management level, respectively. The index for all companies is 2.8 (perceived as strongly insufficient), 3.2 (perceived as strongly insufficient) for large companies, and 2.7 (perceived as strongly insufficient) for SMEs and university ventures. For high level experts with advisory roles to STI policies, the index is 2.5 (perceived as strongly insufficient).

Based on the above, in the sub-category of promoting open innovation, both "Industry-academia-government efforts to develop open innovation sites (Q610)" and "Establishment of a standardization promotion system through industry-academia-government collaboration (Q611)" are often perceived as strongly insufficient. Although differences in the indices in any questions do not exceed 0.8, which is used as a guideline

for the index difference, when comparing large companies with SMEs and university ventures, the index is low for SMEs and university ventures, as is the case in the sub-category of building innovation systems.

The following is a summary of the issues raised in the open-ended answers regarding the sub-category: "Efforts regarding open innovation are progressing, but are still insufficient" and "It is important to familiarize the public with open innovation and closed innovation and with the best mix of them."

6-5 International collaboration

In the sub-category of international collaboration, all respondents in the group of active researchers and experts (non-researchers) were asked the following two questions.

- ○ Q612: Do you think that international collaboration in science and technology (e.g., international human networking, international joint research, and so on) is sufficiently implemented?
- ○ Q613: In promoting international joint research, do you think that the Japanese institution (rules for use of research funds, rules for handling intellectual property rights, and so on) is sufficiently appropriate in light of international practices?

In both questions, active researchers were asked about the general situation in Japan in their own research field, and experts (non-researchers) were asked about the general situation in Japan.

Figure 2-21. List of questions and indices on international collaboration

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q612: International collaboration in science and technology	5.2	5.6	5.2	5.2	5.0	6.4	5.4	4.6	5.3	5.1	5.6	4.9	5.0
Q613: Adequacy of the Japanese system for international joint research	4.4	4.3	4.5	4.3	4.5	4.5	4.6	4.2	4.5	4.2	4.5	3.5	4.2

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q612: International collaboration in science and technology	3.4	4.6	3.0	3.5	2.9	3.6
Q613: Adequacy of the Japanese system for international joint research	3.3	3.5	2.9	3.6	2.7	3.3

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q612: International collaboration in science and technology," among active researchers, the index for university natural science researchers is 5.2 (largely perceived as sufficient). By university department field, there is a difference of 1.8 and 0.8 in the index between science (6.4), engineering/agriculture (5.4) and health (4.6), respectively. The index for natural science researchers at national institutes is 5.6 (perceived as sufficient), that for government priority programs researchers is 4.9 (largely perceived as sufficient), and that for SSH researchers is 5.0 (largely perceived as sufficient). University management level and national institute management level among experts (non-researchers), the indices are 3.4 (perceived as strongly insufficient) and 4.6 (largely perceived as sufficient), showing a difference of 1.2 between the two groups. The index for all

companies is 3.0 (perceived as strongly insufficient), for large companies 3.5 (perceived as not sufficient), and for SMEs and university ventures 2.9 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.6 (perceived as not sufficient). Compared to natural science researchers at universities and at national institutes, the indices for university management level, companies as a whole, and high level experts with advisory roles to STI policies are about 2 to 3 points lower.

In "Q613: Adequacy of the Japanese system for international joint research," among active researchers, the index for natural science researchers at universities is 4.4 (perceived as not sufficient). The index for natural science researchers at national research institutes is 4.5 (largely perceived as sufficient), 3.5 (perceived as not sufficient) for government priority program researchers, and 4.2 (perceived as not sufficient) for SSH researchers. Among experts (non-researchers), the indices for university management level and national institute management level are 3.3 (perceived as strongly insufficient) and 3.5 (perceived as insufficient), respectively. The index for all companies is 2.9 (perceived as strongly insufficient), 3.6 for large companies (perceived as strongly insufficient), and 2.7 for SMEs and university ventures (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.3 (perceived as strongly insufficient). Comparing all university natural science researchers and government priority programs researchers, the index for the latter is 0.9 points lower than that for the former. Compared to natural science researchers at universities and at national institutes, the indices for university and national institute management level, companies as a whole, and high level experts with advisory roles to STI policies are about 1 to 2 points lower.

Based on the above, the sub-category of international collaboration shows a gap in perception between active researchers and others in "International collaboration in science and technology (Q612)" and "Adequacy of the Japanese system for international joint research (Q613)." The reason for the gap may be because the respondents from universities and national research institutes assume international collaboration in science, while the respondents from companies mainly assume international collaboration in technological development. Looking at the differences by attribute in detail, Q612 reveals differences in the situation by university department field and differences in perception between the university management level and the national institute management level. The index for Q613 is low in government priority programs researchers compared to natural science researchers at universities, indicating that international collaboration is a key issue for the former. Open-ended answers for the question include: "The rules regarding the ownership of intellectual property rights obtained from international joint research discourage international joint research," and "Restrictions on single-year budgets and research fund expenditure targets are hindering international collaboration."

Other issues raised in the open-ended comments regarding the sub-category include: "The administrative department lacks support for international collaboration, and researchers are forced to shoulder the burden," "International collaboration cannot be freely conducted due to concerns about technology leakage," "Export control regulations have been tightened, increasing the procedural burden," and "Rules on the use of Japanese research funds, such as the inability to deal with cases where cash settlement is required overseas, are impeding international collaboration."

6-6 Research integrity

In the sub-category of research integrity, all respondents in the group of active researchers and experts (non-researchers) were asked the following two questions.

- ○ Q614: Do you think that researchers are sufficiently aware of the risk factors* of conflicts of interest/conflicts of responsibility that arise with the internationalization of research activities?
  Risk factors for conflict of interest: acceptance of research funds, facilities, equipment, and so on from foreign countries.
  Risk factors for conflicts of responsibility: holding status in a foreign institution, and so on.
- ○ Q615: Do you think that organizational efforts* are sufficiently implemented to address the risks of conflicts of interest/conflicts of responsibility arising from the internationalization of research activities?
  Establishment and dissemination of a system for reporting and consultation by researchers at universities, research institutes, and so on.

In either question, active researchers and university and public research institute management level among experts (non-researchers) were asked about the status of their organizations, while companies were asked about the status of their related Japanese universities, and high level experts with advisory roles were asked about the general status of Japanese universities.

Figure 2-22. List of questions and indices on research integrity

Active researchers	University/natural sciences										Research institutes/ natural sciences	Government priority programs *1	SSH
	Univ. whole	By univ. group				By scientific field			By sex				
		Group 1	Group 2	Group 3	Group 4	Science	Eng/Agri	Health	Male	Female			
Q614: Researchers' awareness of risk factors associated to research activities' internationalization	5.6	5.8	5.6	5.3	5.6	6.2	5.6	5.3	5.6	5.4	5.8	5.0	5.7
Q615: Organizational efforts to address risk factors associated to research activities' internationalization	5.6	6.0	5.9	5.2	5.4	6.2	5.7	5.3	5.6	5.5	5.9	5.0	5.5

Experts (non-researchers)	Univ. management level	research institute management level	Companies			High-level experts
			Whole	By company type		
				Large companies	SMEs/Univ. ventures	
Q614: Researchers' awareness of risk factors associated to research activities' internationalization	4.5	4.9	3.3	4.0	3.1	3.3
Q615: Organizational efforts to address risk factors associated to research activities' internationalization	4.9	5.1	3.4	3.8	3.3	3.3

Note 1: Government priority program researchers are researchers in natural sciences. They are separately selected from natural science researchers at universities and those at national research institutes.

Note 2: The numbers in the cells represent the index for each tabulation unit (column name). The index is the average of the values converted from the individual responses on a 6-point scale from 0 to 10 points.

In "Q614: Researchers' awareness of risk factors associated with the internationalization of research

activities," among active researchers, the index for natural science researchers at the university is 5.6 (perceived as sufficient). By university department field, there is a difference of 0.9 in the index between science (6.2) and health (5.3). The index for natural science researchers at national institutes is 5.8 (perceived as sufficient), 5.0 (largely perceived as sufficient) for SSH researchers, and 5.7 (perceived as sufficient) for government priority programs researchers. Among experts (non-researchers), the indices for university management level and national institute management level are 4.5 (largely perceived as sufficient) and 4.9 (largely perceived as sufficient), respectively. The index for companies as a whole is 3.3 (perceived as strongly insufficient), for large companies 4.0 (perceived as not sufficient), and for SMEs and university ventures 3.1 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.3 (perceived as strongly insufficient). Compared to natural science researchers at universities and at national institutes, the indices for university and national institute management level, companies as a whole, and high level experts with advisory roles to STI policies are about 1 to 3 points lower.

In "Q615: Organizational efforts to address risk factors associated with the internationalization of research activities," the overall index for university natural science researchers among active researchers is 5.6 (perceived as sufficient). By university group, there is a 0.8-point difference in the index between Group 1 (6.0) and Group 3 (5.2). By university department field, there is a 0.9-point difference in the index between science (6.2) and health (5.3). The index is 5.9 (perceived as sufficient) for natural science researchers at national institutes, 5.0 (largely perceived as sufficient) for government priority programs researchers, and 5.5 (perceived as sufficient) for SSH researchers. Among experts (non-researchers), the indices for university management level and national institute management level are 4.9 (largely perceived as sufficient) and 5.1 (largely perceived as sufficient), respectively. The index for companies as a whole is 3.4 (perceived as strongly insufficient), for large companies 3.8 (perceived as insufficient), and for SMEs and university ventures 3.3 (perceived as strongly insufficient). For high level experts with advisory roles to STI policies, the index is 3.3 (perceived as strongly insufficient). Compared to natural science researchers at universities and at national research institutes, the indices for the companies as a whole and for high level experts with advisory roles to STI policies are about 2 to 3 points lower.

Based on the above, the sub-categories of research integrity, "Researchers' awareness of risk factors associated with the internationalization of research activities (Q614)" and "Organizational efforts to address risk factors associated with the internationalization of research activities (Q615)," revealed a gap in perception between active researchers and university and national institute management level, and experts (non-researchers). The cause of the gap may be that researchers at universities and national research institutes assume the risk of conflict of interest/conflict of responsibility arising from internationalization in science, while respondents from companies assume the risk of conflict of interest/conflict of responsibility in technology. The open-ended answers regarding the sub-category include: "Understanding of research integrity is not well developed, and policies need to be developed to support it" and "My organization is emphasizing research integrity associated with international joint research, and is making efforts for this purpose."

7 Report Summary

The NISTEP TEITEN Survey is a continuous opinion survey of active researchers and experts (non-researchers) in academia, government and industry to grasp changes in the state of science and technology and innovation creation in Japan. In Part 2 of this volume, the results of the NISTEP TEITEN Survey 2021, which is the initial survey and the reference point of the 4th NISTEP TEITEN Survey[1] to be conducted during the Sixth Basic Plan period (FY2021-25) have been presented.

In the NISTEP TEITEN Survey 2021, the perceptions of respondents regarding various aspects of science, technology, and innovation, were analyzed focusing on differences in their attributes. As a result, gaps in perceptions depending on the attributes of the respondents were observed in many questions. Possible causes of the gaps include (1) differences in the positions within organization to which the respondent belong, (2) degree of penetration of initiatives (it takes time for implemented initiatives to penetrate), (3) localization (implemented initiatives are limited), and (4) visibility (implemented initiatives are difficult to see from the outside).[2] For example, if the perception gap is due to the degree of penetration of initiatives, it is expected that the gap among attributes will decrease over time. However, if the perception gap is due to localization or visibility, changes in the gap between attributes will be limited to a few attributes. Taking into account these characteristics of the index, we will track time-series changes in the index and the underlying environmental changes in the next fiscal year and beyond.

Since the NISTEP TEITEN Survey 2021 is the first-year survey, it is not possible to discuss changes in the state of science, technology, and innovation creation during the 4th TEITEN Survey period. Here, five points are summarized based on importance for close monitoring to understand the situation during the Sixth Basic Plan period. The first four points are based on the survey results of respondents other than SSH researchers, and fifth point is about the characteristics of the responses by SSH researchers, who are newly added to the survey respondents in the 4th TEITEN Survey.

7-1 Ongoing awareness of issues regarding academic research and basic research and research time, etc.

The series of past NISPTEP TEITEN Survey has indicated continuous awareness of the issues on academic research and basic research, which are essentially important as researchers' activities, and on the research time that is indispensable for conducting research. As mentioned at the beginning of this report, it is not possible to simply compare the results of past surveys with those of the current survey, but the NISTEP TEITEN Survey 2021, with its newly selected respondents, continued to show a similar awareness of the issues.

Specifically, the indices for the part on academic research and basic research are low overall, indicating that challenges are recognized in terms of the environment for exploring new themes and for conducting challenging

[1] The NISTEP TEITEN Survey has been conducted for a total of 15 years: the 1st NISTEP TEITEN Survey (FY2006-2010) corresponding to the 3rd Basic Plan, the 2nd NISTEP TEITEN Survey (FY2011-2015) corresponding to the 4th Basic Plan, and the 3rd NISTEP TEITEN Survey (FY2016-2020) corresponding to the 5th Basic Plan.

[2] In addition to this, it is possible that there are cases in which respondents perceive the term differently depending on their attributes. For example, with regard to the term innovation, respondents from companies may place more emphasis on economic value, while those from universities and national research institutes may place more emphasis on scientific value.

research based on intrinsic motivation, and in terms of diversity in basic research and of international excellence. At the same time, it is perceived as insufficient in terms of securing recurrent or block grant funding and research time and of developing or securing specialists in research management.

The results of the survey and related surveys in the past suggest a structural problem that challenges in research environment hinder promotion of academic research and basic research. The research environment issues identified were those related to recurrent or block grant funding and those related to research time. Regarding the former it was pointed out, for example, that applications for competitive funding on completely new research themes are likely not to be selected, and that recurrent or block grant funding is important when exploring them.[1] On a related note, there are also opinions pointing out the concentration of large research funds on certain researchers in open-ended answers to the survey. Regarding the latter, securing research time as a prerequisite for conducting research activities is no longer viable. There are two points suggested from the open-ended answers as the background. Firstly, "Due to the lack of technical and administrative staff, the scope of researchers' duties has expanded, leading to a decrease in research time," as found in those answers, although securing specialized research management personnel such as URAs and administrative assistants is highly important for securing research time for researchers. It is suggested that the current division of labor is not functioning adequately, which is hindering the securing of research time. Secondly, as found in the open-ended answers, "Excessive time is lost in applying for public research funding and for preparing reports for them, such as having to prepare multiple academic achievement lists in different formats," suggests that excessive administrative work is also burdening researchers.

In general, it can be said that respondents perceive as the current state of support of academic research and basic research in Japan is not sufficient.

7-2 New trends in R&D activities, such as the transformation of research activities and the use of "comprehensive knowledge"

The Sixth Basic Plan outlines a policy to promote the transformation of research activities through the use of ICT technology, which has been rapidly advancing in recent years and the utilization of "comprehensive knowledge".

Regarding the transformation of research activities, the survey results show that progress varied by university group based on the share of the number of papers. Specifically, the results suggest that universities with small shares do not have sufficient capacity to promote the digitalization of research activities; as the transformation of research activities using ICT technology is an important factor in considering future competitiveness in research, support according to organizational conditions is desirable. In addition, the high evaluation by researchers at national research institutes suggests that the digitalization of research is relatively advanced at national research institutes. Sharing with universities the know-how and facilities that support such digitalization is also considered important for promoting the transformation of research activities in Japan as a whole. Going remote in research exchange, education, etc. is generally highly evaluated. This suggests that all

[1] In the NISTEP TEITEN Survey 2020, a question regarding financial resources for exploratory research was asked in the in-depth survey conducted in a single year. In the open-ended questions to the same question, several responses were received to the same effect.

organizations had no choice but to engage in remote activities due to the outbreak of the COVID-19, and that such a sudden change in circumstances has the power to change the way organizations are organized.

In summarizing the responses to the open-ended questions regarding the negative impact of the COVID-19 infection, the following comments were found: "Regional collaboration, industry-academia-government collaboration, and international collaboration have been greatly reduced," "Face-to-face interaction has decreased, which is problematic in terms of human relations and management," "I feel that regional universities have become more isolated because there are few opportunities for researchers from all over Japan to meet together," and " In experimental research, remote instruction and guidance has limitations from the standpoint of safety management. " The survey will pay attention to whether these negative effects will continue in the next and subsequent years.

Regarding the utilization of "comprehensive knowledge" from the aspect of collaboration among different fields, the evaluation by researchers is high both at the stage of setting research themes and at the stage of promoting research, indicating that the researchers themselves recognize that they are engaged in cross-disciplinary collaboration based on their own research themes. While, the management level at universities and national research institutes, companies, and high level experts with advisory roles to STI policies, who observe the researchers' activities from the outside, have relatively low evaluations. In particular, the situation in which the researchers and the management group have very different perceptions suggests that the range of "comprehensive knowledge" may differ, as the researchers answered based on their own research field, whereas the management group answered based on organizational activities.

7-3 Young researchers, young students aspiring to become researchers, and issues regarding the evaluation of researchers' performance

As for the status of young researchers, while the majority perceived as largely sufficient the establishment of an environment for young researchers to be independent and active, the majority perceived as not sufficient the number of young researchers independently conducting R&D, except for Group 1 universities, which have a large share of the number of papers. In particular, the results suggest that, although an environment for young researchers to be independent and active is being established at Group 2 to Group 4 universities, it has not led to an increase in the number of young researchers independently conducting R&D. In addition, the situation is relatively low in terms of the evaluation of the enhancement of tenured employment for young researchers with proven achievements, suggesting the possibility that the lack of tenured employment for young researchers is hindering independent research and development by young researchers. For example, if the financial source of fixed-term employment is derived from a research project, research is usually required to follow the project's policy, making it difficult to conduct R&D independently. While, in Group 1 universities, which are universities with a large share of papers, it is suggested that although there are a certain number of young researchers who are engaged in independent research, they are not provided with commensurate tenured employment, which may be due to constraints in the university administration.[1]

[1] In this regard, the TEITEN Survey Committee pointed out that "it is difficult to provide tenured employment based on external funds" and "it is difficult

Regarding the situation of young research personnel aspiring to become researchers, it is perceived as significantly insufficient in terms of the number of young students aspiring to become researchers, although the environment is becoming more conducive to doctoral studies. As a background to this, it was pointed out that there are few opportunities to obtain non-tenured positions after obtaining a PhD degree, suggesting the existence of a common problem with the insufficient number of young researchers independently conducting R&D. Regarding efforts to support doctoral students, which have been expanded in recent years, there are opinions from multiple perspectives, such as "support is not sufficient," "support is being provided," and "the support framework is disorganized and difficult to understand. " Since it will take time for the efforts to support doctoral students to progress and spread, the survey will continue to focus on the status of young students aspiring to become researchers in the next and subsequent years.

In all questions regarding the evaluation of researchers' performance, the evaluations by university management level are higher than that of the university natural science researchers. This seems to be a natural tendency, considering the relationship in which university natural science researchers are evaluated by the university management level. However, the fact that several of the respondents in the position of associate professor and below stated that "transparency of the evaluation of researchers' performance is insufficient" in their open-ended responses suggests that the efforts of the university management level are not satisfactory for researchers and that the use of the results of evaluation of researchers conducted by the university management level may not be visible to the researchers. The survey results also suggest that there are issues at the stage of utilizing the results of performance evaluations. Since there is limited information on the status of utilization of evaluations, it is important to grasp the specific situation for the first step.

7-4 Issues in interaction, such as regional revitalization, building innovation systems, and international collaboration

Regional revitalization is rated higher in Group 2 through Group 4 universities, which include many universities outside of metropolitan areas, and tended to be rated higher by engineering and agriculture. This trend is thought to reflect the positioning of the universities and fields of study. However, it should be noted that there are several open-ended responses indicating issues such as "The situation in which researchers and organizations engaged in regional revitalization are not evaluated should be corrected," indicating that there are issues to be addressed at the same time. As shown in the results of the sub-category of university management, universities in Group 3 and Group 4 tend to give relatively low ratings to "Efforts to promote self-improvement by making the most of the organization's individuality and characteristics" and to "Efforts to secure various financial resources. It is important to note that even universities that are currently recognized as being in a relatively good position in terms of promoting initiatives for regional revitalization still face challenges in making the most of their own characteristics and diversifying financial resources.

As for organizational industry-academia collaboration, while the framework for collaboration on the part of universities and national research institutes and feedback from industry-academia collaboration to research are

to provide tenured employment based on external funds if we discuss the retirement system based on the assumption of a post of succession (taken over from before incorporation), but the university could use its own funds while utilizing university bonds and funding." While it is institutionally possible to provide tenured employment based on external funding, there are circumstances in which it is difficult to do so depending on the management environment.

relatively highly rated, the evaluation of activities such as venture creation and exchange of research personnel is relatively low. In the future, it will be necessary to closely monitor whether the relatively advanced framework creation results will translate into more active actual collaborations. In the analysis by university group, Group 3 and Group 4, which are lower in the share of number of papers compared with Group 1 and Group 2, show lower evaluations overall. It is also important to provide support to these universities according to the issues they are facing, as indicated by the open-ended answer, "Good technologies and business ideas can be generated even at regional universities, but there is a large disparity among universities in the environment for making use of these ideas."

Overall, the survey respondents gave low marks to the establishment of an innovation system, reflecting the perception that regulations in Japan are too strict. Although the survey does not provide information on specific cases, there is a need for more opportunities to conduct demonstration tests of cutting-edge technologies and for less restrictive regulations when launching new products. The indices tend to be lower for SMEs and university ventures than for large companies, reflecting the perception that many of the support frameworks and deregulations tend to be implemented in a manner favorable to large companies.

Regarding international collaboration, active researchers tend to rate higher, while experts (non-researchers) lower. This may be because the researchers from universities and national research institutes may have expected international collaboration in science, while the respondents of from companies may have expected international collaboration in technological development. Regarding the "Adequacy of the Japanese system for international joint research," the index for government priority programs researchers, who are considered to be more active in international collaboration, is lower than that for university natural science researchers as a whole, suggesting that government priority programs researchers recognize the need to adapt the rules for using Japanese research funds to international collaboration. While taking into consideration the risks associated with the internationalization of research activities, the rules for the use of Japanese research funds, etc., should not become a disincentive to international collaboration.

7-5 Characteristic trends in responses by SSH researchers

With the expansion of the scope of the Sixth Basic Plan, SSH researchers were added to the respondents of the 4th TEITEN Survey. This section summarizes the characteristics of the responses from SSH researchers.

Perceptions by SSH researchers are similar to those of university researchers in the natural sciences in many of the question items. However, the following questions show differences in perceptions from those of university researchers in the natural science fields. Although the small sample size precludes a simple comparison of the results of the responses by SSH researchers with those of other groups, this section will touch on items in which particularly large differences were observed.

Firstly, "Introducing multi-faceted evaluation of researchers" has received a relatively high evaluation by SSH researchers. This may reflect the situation in the social sciences and humanities, where the methods of publishing research results are more diverse than in the natural sciences. Secondly, regarding "Securing recurrent or block grant funding," which has long been recognized as an issue by natural science researchers,

has received a relatively high evaluation. This may reflect the fact that a higher percentage of research can be conducted with relatively small funds compared to the natural science fields. While SSH researchers tend to give low ratings to the status of academic research and basic research, which is continuously recognized as an issue by researchers in the natural science fields. And finally, in the utilization of "comprehensive knowledge," collaboration among different fields when setting research themes based on social issues is rated higher than by university natural science researchers. However, the difference is smaller for cross-disciplinary collaboration in the implementation phase of research and development.

While "Initiatives for organizational collaboration with the private sector" and "Creation of venture companies" tended to be rated lower by SSH researchers than those of university natural science researchers. This may because many respondents in the social sciences and humanities are in fields that are not familiar with the industrial use of their findings. Note that about 20-30% of the respondents answered "don't know" for these questions. Diversifying career paths for PhD holders are also rated lower than those of university natural science researchers.

7-6 Summary

The 3rd NISTEP TEITEN Survey conducted from FY 2016-20 showed an increasing sense of urgency regarding the infrastructure of research activities at universities and national research institutes. This trend has continued in the current NISTEP TEITEN Survey 2021, in which the survey items and respondents have been revised in line with the Sixth Basic Plan.

While there are positive changes including that going remote in research exchange and education has been penetrated overall, although it has strongly been influenced by external factors such as the response to the COVID-19 infection. In addition, the evaluation by researchers regarding the publication and utilization of research data is relatively high, and as this activity progresses, it is likely that the evaluation by external parties to universities and national research institutes may also increase in the future. Furthermore, efforts by universities to make the most of their own individuality and characteristics are relatively highly evaluated, although the evaluation is somewhat low by the universities in Group 3 and 4 and by outside the universities.

During the period of the Sixth Basic Plan, there is a possibility that significant changes in the status of science, technology and innovation creation will happen, including the above-mentioned points. The survey is going to provide information that contributes to science, technology and innovation policy in the following fiscal years and beyond by timely grasp of changes in the situation through the attitudes of the respondents to the survey.

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